



**R | S | G** INC.  
RESOURCE SYSTEMS GROUP, INC.

## **DRAFT**

■ Documentation for:

### **EAST CALAIS VILLAGE AND VT 14 TRANSPORTATION STUDY**

Calais, VT

■ Prepared for:

### **Central Vermont Regional Planning Commission**

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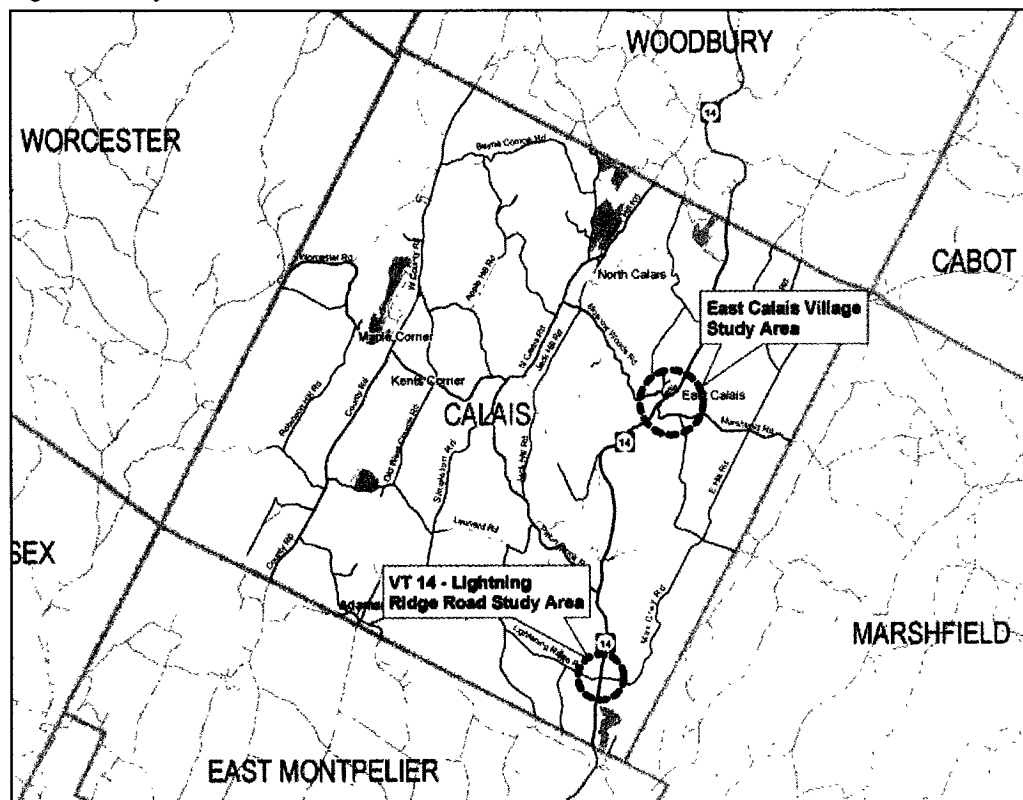


## INTRODUCTION

The East Calais Village and VT 14 Transportation Study is a joint effort of the Central Vermont Regional Planning Commission, the Vermont Agency of Transportation (VTrans), the Town of Calais, the Project Study Committee, and Calais residents and business owners to develop alternatives to address the identified transportation needs in the project's two study areas: East Calais Village and the VT 14-Lightning Ridge Road-Max Gray Road intersection. Figure 1 shows the project area locations.

This report examines existing conditions and develops short- and long-term alternatives to address the identified needs and deficiencies in both of the study areas. In particular, identified areas of concern in the East Calais Village include traffic and pedestrian safety, sight distance, and multimodal accessibility, while the VT 14-Lightning Ridge Road intersection is primarily focused on traffic safety and operational issues.

Figure 1: Study Areas



## STUDY AREA OVERVIEW

Over the past two centuries, the Town of Calais has experienced fluctuating population levels, with a peak population of nearly 1,700 in 1840 (Figure 2). The recent increase in population over the last



four decades is likely tied to a regional movement of population to the towns surrounding the nearby employment centers of Montpelier, Berlin, and Barre. This increasingly commuter-oriented population will continue to rely on VT 14, which travels through both study areas, as a primary route to many of their destinations.

**Figure 2: Calais Population (1800-2000)**

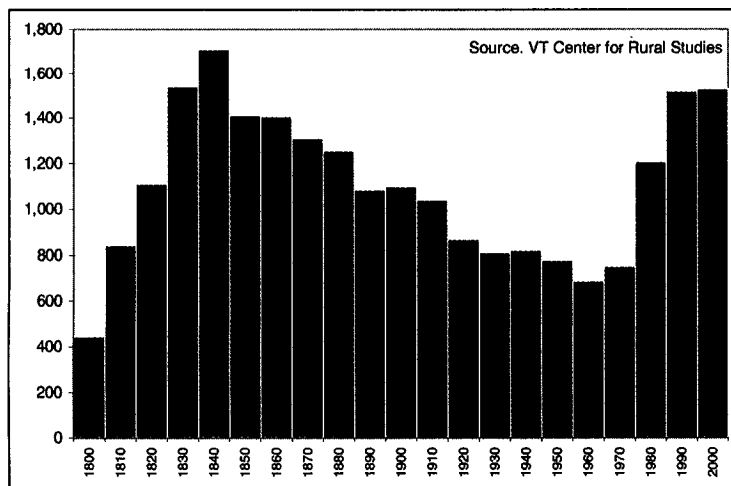


Table 1 shows the location of employment for Calais residents in 2000. Over a quarter of employed Calais residents commute to Montpelier while 21% remain in Calais, 12% commute to Barre City, and 10% travel to Berlin for work daily.

**Table 1: Workplace Locations of Calais Residents - 2000 Census**

Workplace Locations	Count	
	(10 or more)	% of Total
Montpelier city Washington Co. VT	223	28%
Calais town Washington Co. VT	168	21%
Barre city Washington Co. VT	97	12%
Berlin town Washington Co. VT	78	10%
Waterbury town Washington Co. VT	31	4%
East Montpelier town Washington Co. VT	30	4%
Barre town Washington Co. VT	29	4%
Burlington city Chittenden Co. VT	24	3%
Northfield town Washington Co. VT	10	1%

Source: VT Department of Employment and Training

## SUMMARY OF PUBLIC COMMENTS

An East Calais Village and VT 14 Transportation Study Advisory Committee was established with representatives from the Town of Calais, the Central Vermont Regional Planning Commission (CVRPC), the Vermont Agency of Transportation (VTrans), and local business owners and residents. The Advisory Committee held a kick-off meeting on 6 August 2003 in the Calais Town Hall. CVRPC





and Resource Systems Group (RSG) staff provided an overview of the study purpose and schedule. Comments from the Committee focused on safety issues at both study locations, pedestrian access issues, traffic issues, and a proposed park and ride lot.

The Advisory Committee hosted a Local and Regional Consensus Meeting on 22 September 2003 in the Calais Town Hall. The meeting was attended by members of the Advisory Committee as well as 15 interested residents. The comments made at this meeting are summarized as follows:

- There has been one additional accident in East Calais in 2003;
- Consider a paved apron and stop bar at VT 14/Back Street intersection;
- Consider a traffic signal at VT 14 & Marshfield Road;
- Examine alignment and placement of stop sign at Marshfield Road;
- Many people use Back Street to avoid unsafe Marshfield Rd intersection;
- VT 14/Marshfield Road intersection unsafe;
- High speeds on VT 14 north of village (50 mph near ballfields too fast);
- Investigate effects on speed from increased police enforcement or LED speed signs;
- Place flashing lights in advance of village to slow traffic;
- Potentially expand 35 mph speed zone north and south of village;
- Reduce speed to 25 mph in village;
- Investigate traffic calming techniques in village (islands, tables, rumble strips, etc.);
- Add crosswalks and pedestrian crossing sign across VT 14 to General Store;
- Additional volume on Back Street may conflict with pedestrians;
- Is there enough room for sidewalks in village?;
- Pedestrian destinations in village include store, post office, church, neighbors;
- Potential truck conflict with vehicles stopped for crossing pedestrians in village;
- Who will clear/ maintain sidewalks?;
- Heavy trucks need more time/space to stop safely;
- High Truck Traffic (Granite Trucks, Cassella Waste Mgmt.);
- Problems with truck turning radii at Back Street and Marshfield Road;
- New Marshfield Road alignment: Opposite Moscow Woods Road;
- New Marshfield Road alignment: South of existing alignment to VT 14;
- Consider re-aligning and straightening VT 14 through the village?;
- Is there a demand for a park and ride?;



- What is the best use for the ballfield parking area?;
- Get traffic count data on Back Street;
- Consider moving church from Marshfield Road north across from ballfield;
- Should Back Street be paved?;
- Cars follow too closely behind cars pulling out - no room to back up;
- Add mirror along VT 14 to increase sight distance;
- Cut back banks and vegetation along VT 14 to increase sight distance;
- Eliminate passing zone on VT 14 near intersection with Lightning Ridge Road;
- Narrow the Lightning Ridge approach and add stop bar;
- Add flashing light at VT 14/Lightning Ridge Road intersection during school hours;
- Pave apron and add stop bar to Max Gray approach;
- Remove vertical dip in VT 14 north of Lightning Ridge Road intersection;
- Add left turn lane for northbound VT 14 turns onto Lightning Ridge;
- 2 additional accidents at VT 14/Lightning Ridge Road intersection in 2003.

RSG staff met with the CVRPC Transportation Advisory Committee (TAC) on 23 September 2003 to provide an overview of the project. The TAC was briefed on the purpose and schedule of the project. The following comments were made by TAC members regarding the project:

- Use of Back Street may be an OK alternative. Would probably require two ten-foot travel lanes and a sidewalk. Is there enough room for this?
- Members of the TAC were familiar with the VT 14/Marshfield Road intersection and agreed it is a poorly designed and potentially dangerous intersection
- Several members of the TAC were very familiar with this intersection and agreed it is a hazardous location.
- One TAC member pointed out that the low crash rate suggests that the location is not critical. He was concerned that any modification could result in increased speeds and higher crash rates. Other TAC members challenged his conclusion that the intersection is not dangerous.
- One member felt that lowering the "hump" in VT 14 north of the intersection and raising the Lightning Ridge Road and Max Gray Road approaches would be low cost and should be considered. Steve Gladczuk pointed out that the VTrans District Transportation Administrator (DTAs are responsible for maintenance, snow plowing, etc) estimated the cost at \$150,000, not including right of way costs or environmental or historic impacts.



- A suggestion was made to add centerline striping to the Lightening Ridge Road approach. The striping would encourage drivers to exit as far north as possible. This could be implemented quickly and is very low cost.

#### **OVERVIEW OF DATA SOURCES**

As the scope of this project did not allow for detailed land surveys, elements of the analyses in this report have relied on the best current source(s) of information. These sources include the following: 1) a 1946 route survey along VT 14 in East Calais Village conducted for a VT 14 reconstruction/resurfacing project, 2) all relevant electronic and paper map coverages made available by state, regional and local agencies and those coverages already in RSG's possession, and 3) data collected during site visits. A more formal investigation, involving detailed land surveys will be required to determine precise implementation costs, impacts, and required permits for the alternatives presented in this report.



## EAST CALAIS VILLAGE STUDY AREA

*"The Marshfield Road intersection is characterized by the ambiguous layout around the church which impinges on safety and capacity, and sightlines and level stopping lines at Route 14 are poor."*

- Calais Town Plan – Transportation Element, 1993

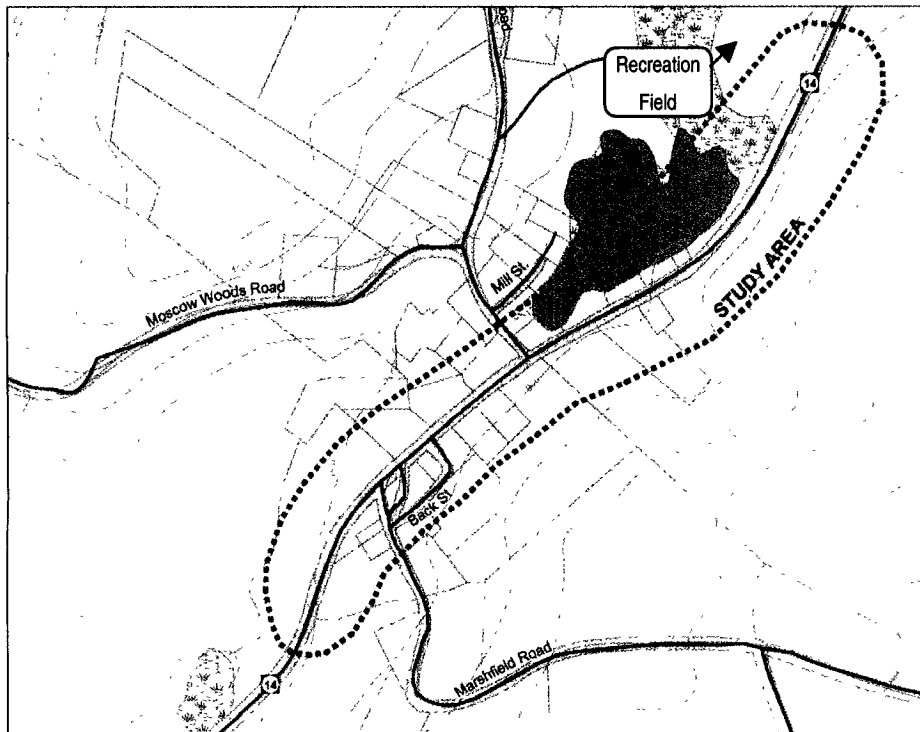
*"The lack of pedestrian walkways in the East Calais village center produces undesirable conflicts between vehicular traffic and pedestrian traffic. Sidewalks and traffic calming should be considered. The Route 14 intersections with Marshfield Road, and Moscow Woods Road should be reconstructed. Consideration should be given to establishing a park-ride lot on Route 14 in Calais."*

- Central Vermont Regional Transportation Plan, CVRPC, 2003

## PROJECT AREA

The East Calais Village study area extends a half-mile along VT 14 from approximately 600 feet south of Marshfield Road through the village north to the recreation field (Figure 3). Significant features in the study area are a general store and gas station, a community church, recreation fields, and approximately 20 homes. The village post office is on Mill Street just outside of the study area.

Figure 3: East Calais Village Study Area



## PURPOSE & NEED STATEMENT

Based on the existing and projected conditions inventoried along the study corridor, and comments from Calais residents and local, regional, and state officials, a purpose and need statement was developed for the East Calais Village Study Area. The study area purpose defines the specific objectives to be addressed in the evaluation. The needs identify specific issues to be addressed within the study area to achieve the study area purpose. The purpose and need statements help to guide the development of project area recommendations.

### ***Study Area Purpose – East Calais Village***

The purpose of this project in the East Calais Village study area is to improve roadway safety and operational efficiency and to enhance multimodal transportation options throughout the defined study area.

### ***Study Area Needs – East Calais Village***

#### Safety

- Inadequate sight distance for vehicles entering and exiting the VT 14-Marshfield Road intersection increases the potential for crashes. This lack of sight distance is of particular concern when trucks are involved because they require longer distances to stop than passenger vehicles.
- Truck traffic through the village conflicts with pedestrians and/or turning vehicles.
- Vehicle speeds exceed the posted speed through the village further intensifying safety problems associated with inadequate sight distance and increasing the potential for crashes between turning vehicles and pedestrians.
- The stop sign on the Marshfield Road approach to VT 14 is oriented such that it appears to be directed at traffic traveling northbound on VT14. This orientation confuses drivers not familiar with the area and increases the potential for rear end collisions.

#### Operational Inefficiencies

- Marshfield Road east of VT 14 is bisected by the Community Church of East Calais. The result is an awkward approach that consists of two segments that each allow two-way traffic with sharp turns as they pass around all four sides of the church. The two segments merge again near the Back Street-Marshfield Road intersection. This awkward alignment creates additional conflict points, has geometric constraints for trucks, and is confusing for passenger vehicles.
- Some of the Marshfield Road traffic diverts to Back Street to avoid the Marshfield Road-VT 14 intersection and to enter VT 14 at a point with greater sight distance. However, Back Street is a local gravel road in a residential area that is not currently designed to carry through traffic.



- Parking along Main Street for the General Store is often not sufficient to handle parking demand.

#### Lack of Multimodal Transportation Options

- No sidewalks or crosswalks are provided despite the presence of several origins and destinations within close proximity of each other in the village. Origins and destinations of significance include the General Store, the post office, residential areas, the community church, and the recreation field.
- There is a growing need for a park and ride facility to serve Calais residents. The Town of Calais is a bedroom community with many residents traveling to the Montpelier/Barre/Berlin employment center. A park and ride lot centrally located in Town could serve commuters and reduce the number of vehicle trips to the surrounding employment centers.

### EXISTING CONDITIONS – EAST CALAIS VILLAGE

#### **Roadway Characteristics**

VT 14, which also serves as Main Street for East Calais Village, is classified as a minor arterial and carries approximately 3,600 vehicles per day. VT 14 links the Town of Calais with Montpelier, Barre and I-89 to the south, and to Woodbury and Hardwick to the north. Marshfield Road, which is a Class 2 town highway and classified as a rural minor collector, connects East Calais Village with US 2 to the east. Marshfield Road carries approximately 400 vehicles per day.

The typical cross-section of VT 14 through East Calais Village includes two 12-foot lanes and 2-foot shoulders. The typical cross-section of Marshfield Road adjacent to the village includes two 10-foot lanes with no shoulders. Figure 4 compares existing conditions along the sections with established minimum design standards.

**Figure 4: Existing Conditions and Design Standards on VT 14 and Marshfield Road**

#### **VT 14 - Village Minor Arterial**

	Design Standard*	Existing
Lane Width	> 11 ft.	12 ft
Shoulders	> 2 ft.	2 ft. (varies)
Max. Grades	< 9%	8.0%, 6.5%, 5.8%
Curves **	> 350 ft.	575 ft., 820 ft.

#### **Marshfield Road - Village Minor Collector**

	Design Standard*	Existing
Lane Width	> 9 ft.	10 ft.
Shoulders	> 2 ft.	0 ft.

\* Based on VT State Design Standards, VTrans, 1997

\*\* Based on A Policy of Geometric Design of Highways and Streets, AASHTO, 2001



**Traffic**

Based on traffic counts conducted in 2003, the Average Annual Daily Traffic (AADT) volume on VT 14 in East Calais Village is approximately 3,620 vehicles, while on Marshfield Road east of VT 14 the AADT is approximately 400 vehicles. During the peak hour (5:00-6:00 PM) these volumes equate to roughly 6 cars per minute on VT 14 and approximately one car every 1.5 minute on Marshfield Road. Table 2 below shows projected traffic volumes at these two locations for the following years: 2003, 2008, and 2013. The future year volumes are based on an average annual growth rate of 1.8%<sup>1</sup>.

In terms of the types of vehicles traveling along VT 14 and Marshfield Road, just over 90% are light-duty vehicles (i.e. passenger cars, motorcycles, pick-up trucks). 5% of the traffic along VT 14 through East Calais Village is comprised of medium-duty trucks (i.e. buses, vans, single-unit trailers) and 4% is comprised of large-duty trucks (i.e. 4 or more axle single- and multi-unit trailers). The statewide average for minor arterials such as VT 14 is 92% light-duty, 5% medium-duty, and 3% large-duty, which is very close to the distribution on VT 14 through East Calais Village.

Along Marshfield Road, 8% of the traffic is comprised of medium-duty trucks and 1% is comprised of large-duty trucks. The statewide average for minor collectors such as Marshfield Road is 95% light-duty, 4% medium-duty, and 1% large-duty. The distribution of medium-duty trucks on Marshfield Road is somewhat higher than the statewide average for minor collectors. Table 2 below shows vehicle classification counts at the two locations in the village.

Vehicle speeds at two locations in the East Calais Village study area were collected in 2003 using an automatic traffic-recording unit. Table 2 shows the posted speed at the two locations along with the measured median speed and 85<sup>th</sup> percentile speed<sup>2</sup>. Despite the posted 35 mile per hour speed limit through the village, the 85<sup>th</sup> percentile speed is significantly higher at 43 miles per hour. Similarly on Marshfield Road, the 85<sup>th</sup> percentile speed of 37 miles per hour is almost 50% higher than the 25 mile per hour posted speed.

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<sup>1</sup> 1.8% growth rate based on growth rate assigned to "US 2 - VT 14 North" sub-region in the 2003 Central Vermont Regional Transportation Plan, page 49.

<sup>2</sup> The 85<sup>th</sup> percentile speed is a commonly used traffic design and planning metric. It portrays the speed at which 85% of the measured vehicles are traveling at or below.



**Table 2: Volume, Vehicle Classification and Speed in East Calais Village**

	VT 14 In East Calais Village	Marshfield Road East of VT 14
<b>Traffic Volumes</b>		
2003 AADT	3,620	400
2008 AADT*	3,950	430
2013 AADT*	4,320	470
<b>Vehicle Classification</b>		
Light-Duty (Motorcycles, Cars, Pick-ups)	91%	91%
Medium-Duty (Buses, Vans, Single-Unit Trailers)	5%	8%
Heavy-Duty (4+ Axle Single and Multi-Unit Trailer)	4%	1%
<b>Speed</b>		
Posted Speed	35 mph	25 mph
Median Speed **	37 mph	30 mph
85th Percentile Speed **	43 mph	37 mph

\* Projections

\*\* Speeds measured in field

**Intersection Capacity Analysis**

Traffic turning movement counts were conducted at the VT 14-Marshfield Road intersection in 2003 during the morning and evening peak hours. The traffic count volumes were then used to conduct a capacity analysis for the intersection. Level of Service (LOS) is a qualitative measure describing the intersection operating conditions as perceived by motorists driving in a traffic stream, based on the average delay per vehicle. The 2000 Highway Capacity Manual defines six grades of LOS at an intersection (Table 3). The delay thresholds for levels of service at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions.

**Table 3: LOS Criteria for Signalized and Unsignalized Intersections**

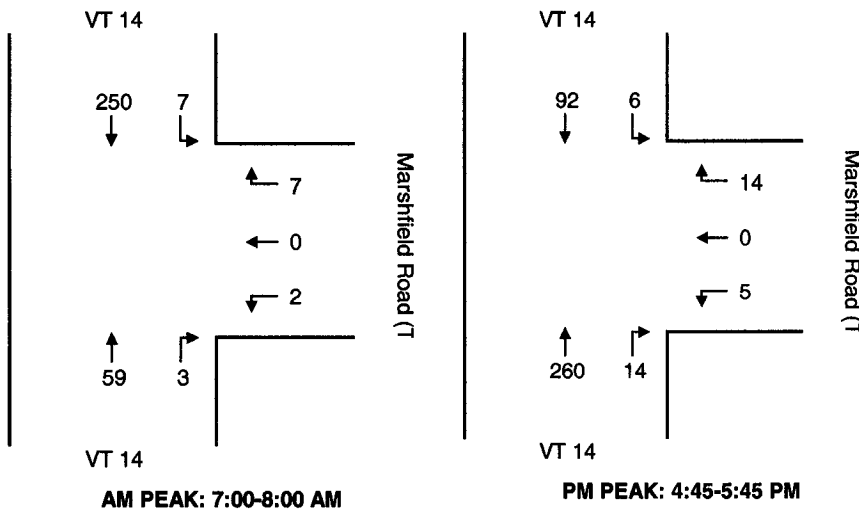
LOS	Characteristics	--Unsignalized-- Total Delay (sec)	--Signalized-- Total Delay (sec)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

Figure 5 shows the vehicular volumes collected during the count.





Figure 5: Turning Movement Volumes at VT 14-Marshfield Road



The volumes at the VT 14-Marshfield Road intersection were adjusted to Design Hour Volume<sup>1</sup> (DHV) conditions before conducting the intersection capacity analysis. The results of the stop-controlled congestion analysis is shown below in Table 4. The analysis shows that during both the morning and evening peak, the intersection is operating well from a capacity perspective with only minimal delay experienced at the stop-controlled approaches. Detailed capacity analysis worksheets can be found in Appendix C.

Table 4: VT 14 - Marshfield Road Capacity Analysis Results

	2003			
	AM		PM	
	LOS	Delay (sec)	LOS	Delay (sec)
VT 14 / Marshfield Road				
Westbound Left/Right, from Marshfield Rd	A	9	B	10
Southbound Left, from VT 14	A	7	A	8

### Safety

Between 1990 and 2001 there were a total of four reported accidents along VT 14 in the study area (Figure 6). Moving north along the corridor, the first accident occurred at the VT 14-Marshfield Road intersection in 1992. The accident was a head-on collision resulting from a failure to yield right of way and resulted in 4 injuries. The second accident occurred in 1997 in front of the village general store. The accident involved a collision with a pedestrian caused by inattention and resulted in one injury. The third accident occurred at the VT 14-Moscow Woods Road intersection in 1993. The accident was a head-on collision resulting from a failure to yield right of way and resulted in 1 injury.

<sup>1</sup> The design hour is defined as the 30<sup>th</sup> highest hour of traffic for a roadway within a year. It is a relatively highly congested hour of analysis, with over 99.5% of all hours in a year being less congested than the design hour.



The fourth accident occurred just north of the VT 14-Moscow Woods Road intersection in 1990. The accident was caused by an improper turn and resulted in no injuries.

**Figure 6: Reported Accidents in East Calais Village (1990-2001)**

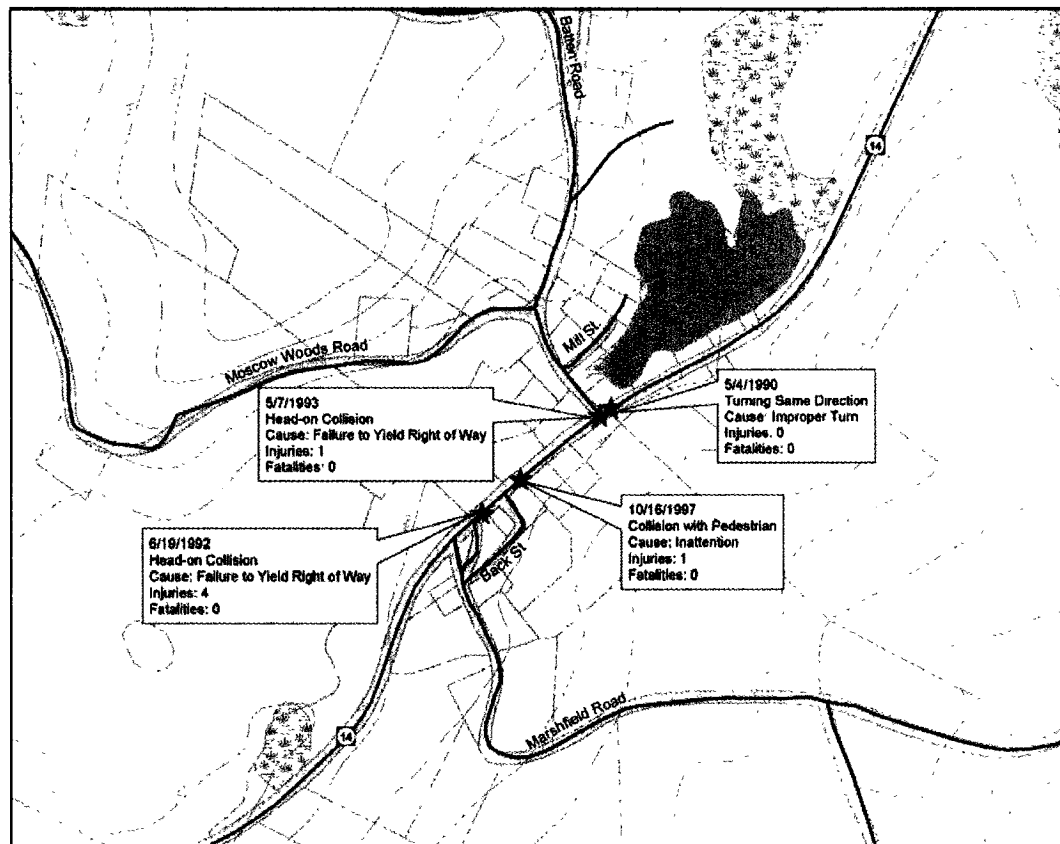


Table 5 summarizes the accident data along the ½ mile segment of VT 14 through East Calais Village during the twelve-year period (1990-2001). The actual-to-critical rate during this period is 0.217. An actual-to-critical rate greater than 1.0 categorizes a High Accident Location. The Statewide average segment crash rate for rural arterials in this time period was 0.610.

**Table 5: VT 14-East Calais Village Segment Accident Analysis (1990-2001)**

	Total Accidents (1990-2001)	Injuries	Actual Rate (Acc/Million Vehicle Miles)	Critical Rate (Acc/Million Vehicle Miles)	Actual/Critical Rate
VT 14 thru East Calais Village	3600	6	0.507	2.335	0.217



### Sight Distance

The lack of sight distance at the VT 14-Marshfield Road was acknowledged by state, regional, and local officials and Calais residents as a high area of concern in the study area<sup>1</sup>. The posted speed on VT 14 through the village is 35 miles per hour, however, as the previous section noted, the majority of vehicles travel through the village at speeds over 40 miles per hour. Nearly 10% of the traffic (approximately 360 vehicles) is comprised of medium- or large-duty vehicles, which take longer to stop. In addition, the vertical and horizontal curvature of VT 14 just south of the Marshfield Road intersection provides limited sight distance of turning vehicles at the intersection.

Table 6 shows stopping sight distance measurements at the VT 14-Marshfield Road intersection. Both stopping sight distance<sup>2</sup> and corner sight distance<sup>3</sup> were measured in the field and compared with the minimum standard distances recommended by the American Association of State Highway Transportation Officials (AASHTO)<sup>4</sup> based on the speed of the road being analyzed.

As Table 6 shows, both the stopping sight distance and the corner sight distance for vehicles turning out of Marshfield Road are under the AASHTO recommended minimum. For vehicles traveling south on VT 14 turning left onto Marshfield Road, the stopping sight distance down the hill on VT 14 is 330 feet, which is greater than the AASHTO recommended minimum for this movement.

**Table 6: Sight Distance at the VT 14-Marshfield Road Intersection (deficient distances noted in bold)**

Location	Stopping Sight Distance		Corner Sight Distance		Speed
	Field	AASHTO	Field	AASHTO	
Marshfield Road	<b>235 ft</b>	250 ft	<b>115 ft</b>	390 ft	35 mph
VT 14 SB LT onto Marshfield Road	330 ft	250 ft	--	--	35 mph

### Land Use

Land use in the East Calais Village study area is characterized by a relatively dense village center located along VT 14 and Moscow Woods Road containing a general store, gas station, church, recreation area, post office, and residential homes. Beyond the village, the uses are primarily residential and at a lower density than found in the village area. Figure 7 shows the zoning in and

<sup>1</sup> VTrans conducted a Safety Audit at this intersection on 16 July 2003. The complete VTrans Safety Audit can be found in Appendix F.

<sup>2</sup> Stopping sight distance refers to the minimum distance required by a vehicle traveling on the through route to see a stopped or turning vehicle and come to complete stop. It is often recommended as the minimum safe stopping sight distance at an intersection.

<sup>3</sup> Corner sight distance quantifies the distance needed for a vehicle traveling on the through route to see a turning vehicle and react such that its speed does not reduce by more than 30%.

<sup>4</sup> American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 4<sup>th</sup> Edition. Washington DC, 2001.



around the East Calais Village study area. The majority of the study area is zoned Village, while the remainder is zoned Rural Residential.

**Figure 7: East Calais Village Zoning**

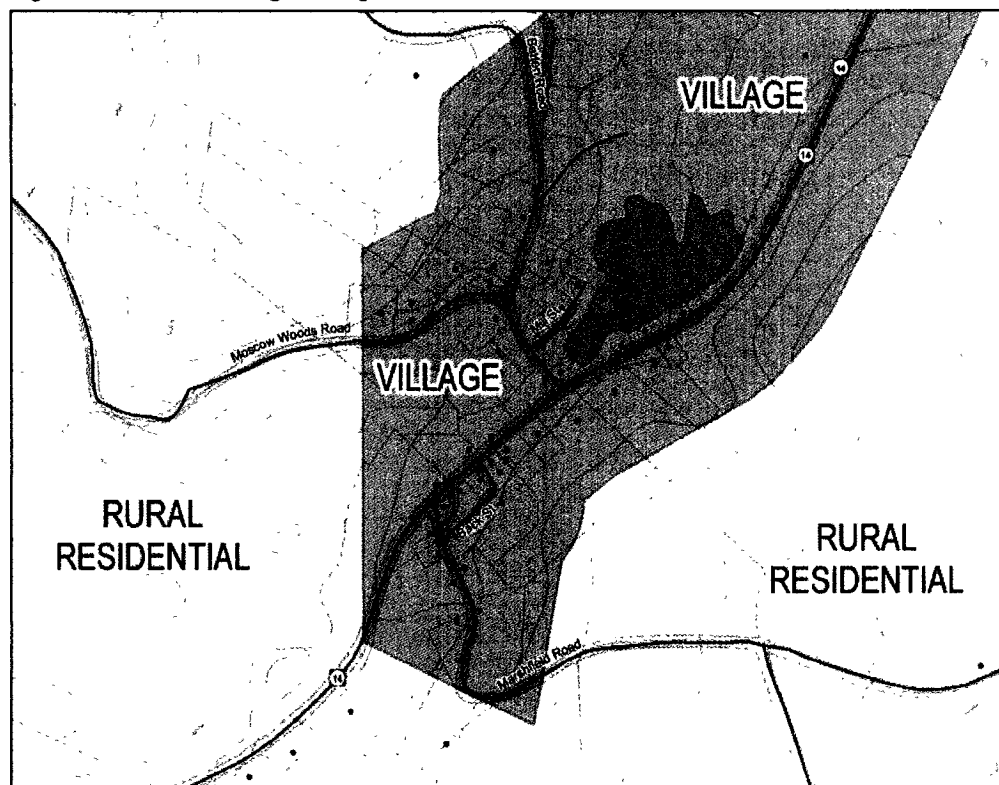


Table 7 shows the Permitted and Conditional Uses in the Village Zone.

**Table 7: Permitted and Conditional Uses in the Village Zone**

<b>Permitted Uses</b>	<b>Conditional Uses</b>
Agricultural and forestry uses	Multi-unit residential facilities
One and two family dwelling units	Museums
Parks	Theaters
Recreational facilities	Communities centers
Professional residence offices	Religious and charitable institutions
Public utility facilities	Schools
Home occupations	Professional offices
	Retail stores
	Hotels
	Restaurants
	Gas stations
	Commercial and light industrial uses
	Major subdivision



Table 8 shows the Permitted and Conditional Uses in the Rural Residential Zone.

**Table 8: Permitted and Conditional Uses in the Rural Residential Zone**

Permitted Uses	Conditional Uses
Agricultural and forestry uses	Museums
One and two family dwelling units	Theaters
Public or private outdoor recreation areas	Communities centers
Reservoirs	Religious and charitable institutions
Cemeteries	Schools
Professional residence offices	Mobile home parks
Public utility facilities	Bed and breakfasts
Home occupations	Restaurants
	Resource extraction areas
	Commercial and light industrial uses
	Major subdivisions

### **Resources – Historic**

A preliminary historic assessment of East Calais Village was conducted in the Fall of 2003 by Hartgen Archeological Associates, Inc. Information from this assessment was supplement with information from the Vermont Division for Historic Preservation.

The first permanent European settlement in Calais was made in 1787 by the Wheelock family and development occurred thereafter surrounding mill sites on the Kingsbury Branch. In 1793, Jacob Davis built the first grist mill and saw mill in East Calais Village. In the early 1800's, East Calais was home to mills for carding wool and dressing cloth and a triphammer shop for making scythes and hoes and a shop for the manufacture of cut-nails.

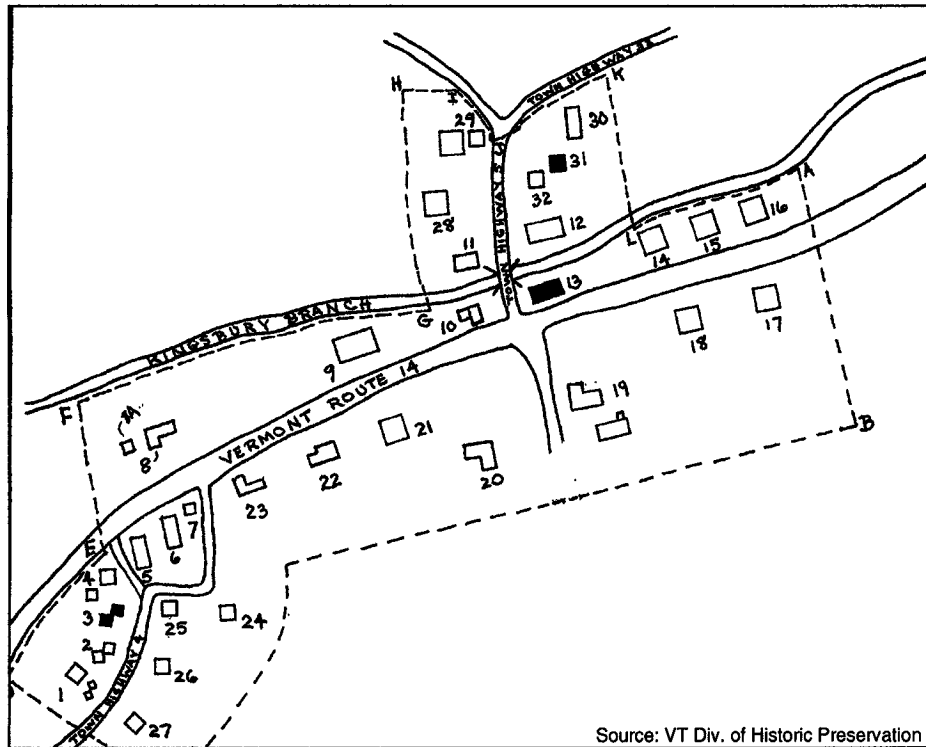
In 1979 the State Register designated the village as an official State Historic District. The district consists of 32 structures: a grist mill, a Greek Revival Church, a store, a post office, a small number of houses built prior to 1850 and a greater number built after the Civil War. "It retains the appearance of a mid- to late 19<sup>th</sup> century village, with much of its well-detailed Greek Revival, Italianate, Gothic Revival, and Queen Anne architecture still extant."<sup>1</sup>

Figure 8 shows the identified East Calais Village designated historic district with contributing structures denoted by hollow boxes and non-contributing structures denoted by black boxes.

<sup>1</sup> VT. Division for Historic Preservation, 1979



Figure 8: East Calais Village Historic District



### Resources - Archeological

A complete archeological assessment was conducted in the Fall of 2003 by Hartgen Archeological Associates, Inc. Their review of the Vermont Archeological Inventory (VAI) and town files revealed no reported archeological sites within 1 mile of the project area. However, the proximity of the East Calais Village study area to the Kingsbury Branch may have attracted early settlers and thus, the potential for precontact archeological deposits exists in the study area.

The Environmental Predictive Model for Location Precontact Archeological Sites analysis, as defined by the Vermont Division for Historic Preservation was conducted for the study areas. The analysis quantifies the potential for precontact archeological sites in the study areas. A score of 32 or greater indicates archeological sensitivity. Based on the analysis conducted for this report, the study areas yielded a sensitivity rating of 56.

A complete archeological assessment can be found in Appendix G.

### Resources – Wetlands

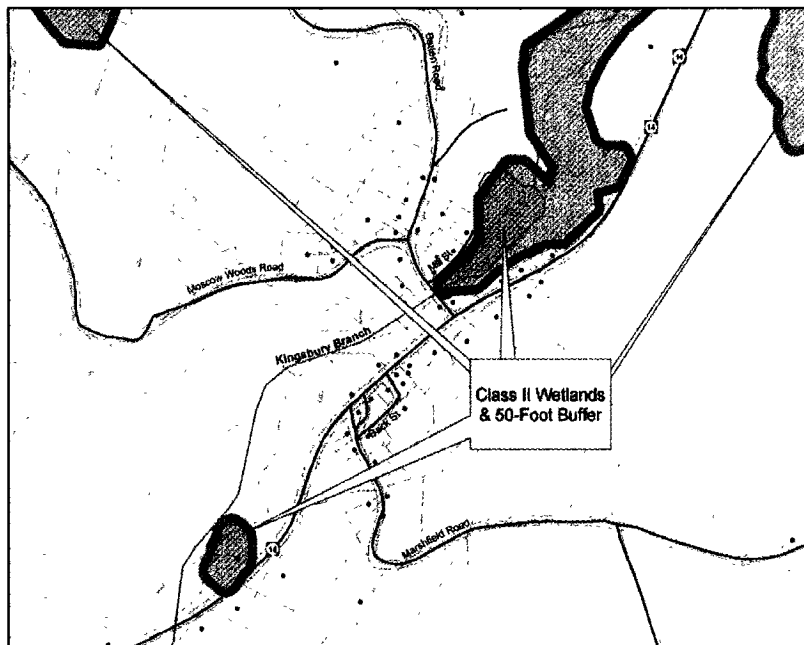
Figure 9 shows the extent of Class II wetlands in the East Calais Village study area. The wetland boundaries are based on the Vermont Significant Wetlands Inventory developed by the Vermont Agency of Natural Resources. Class II wetlands, including a 50-foot protective buffer, are protected under the Vermont Wetland Rules. Any intrusion into the identified wetland or its buffer requires a



Conditional Use Determination from the Water Quality Division of the Department of Environmental Conservation.

Comments received from the Vermont Department of Fish and Wildlife identifies the wetlands to the north of East Calais Village as an area known to provide significant wildlife habitat functions for furbearers and migratory waterfowl.

**Figure 9: Class II Wetlands and 50-Foot Buffer in East Calais Village Study Area**



#### **Resources – Floodplains**

Figure 10 shows the identified floodplain areas in the East Calais Village study area as identified by the Federal Emergency Management Agency (FEMA). The figure identifies the 100-year floodplain along the Kingsbury Branch of the Winooski River. The 100-year floodplain lies very close to VT 14 in the vicinity of Moscow Woods Road.



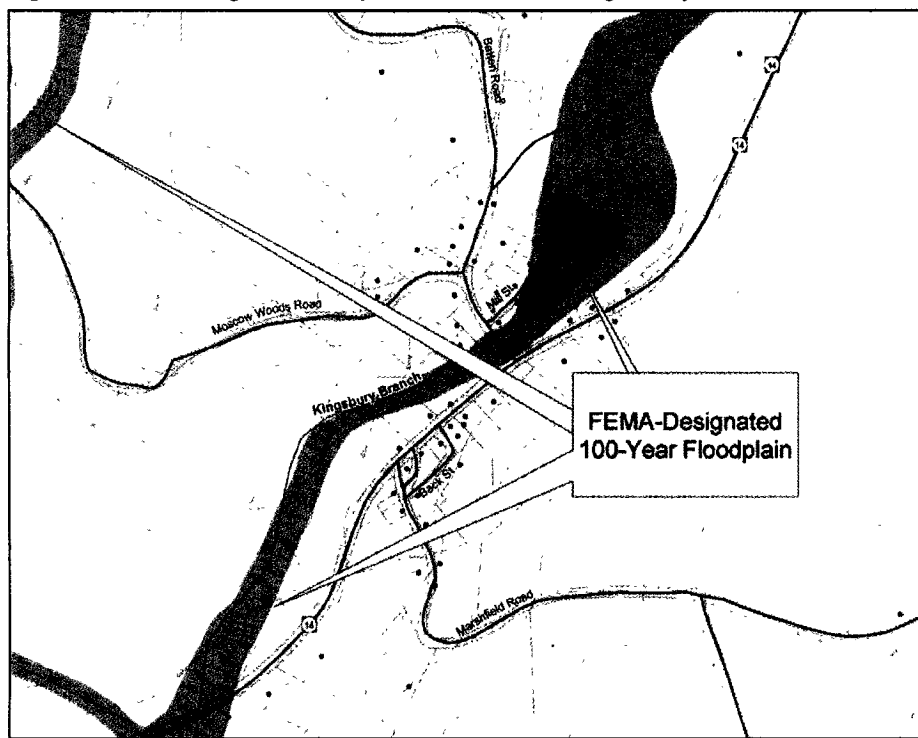
**Figure 10: FEMA-Designated Floodplain in East Calais Village Study Area****Resources – Slopes**

Figure 11 shows a composite image of estimated slopes in the East Calais Village study area. Areas with greater than 20% slope in the study area, shown in orange and red, can be found generally south of VT 14 through the village and east of VT 14 north of the village.





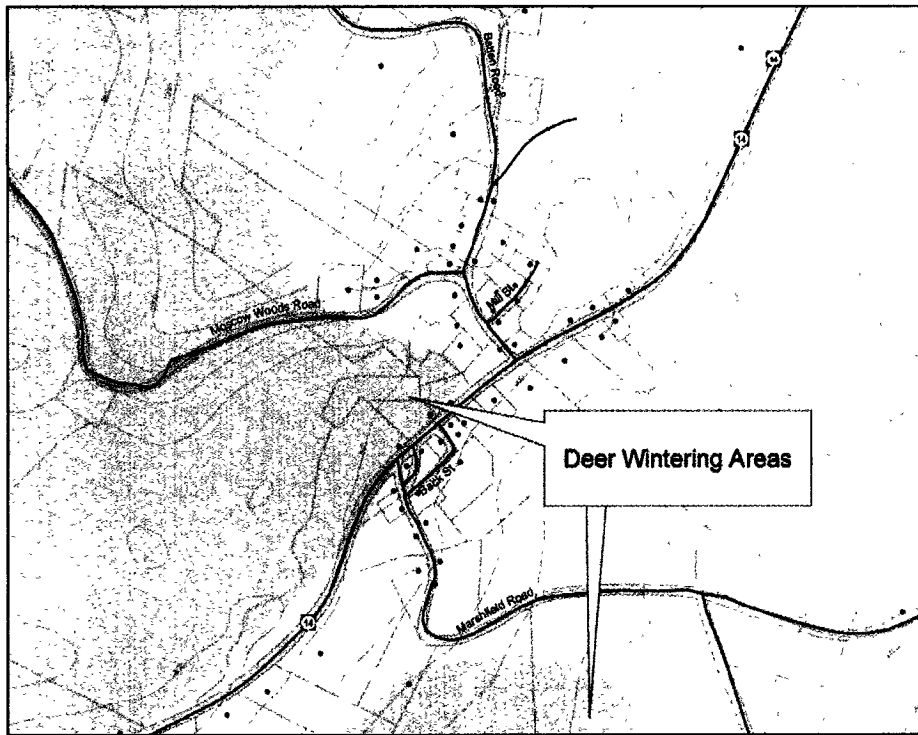
**Figure 11: Estimated Slopes in East Calais Village Study Area****Resources – Endangered Species**

The East Calais Village study area was investigated for the presence of rare, threatened, or endangered species or significant communities as defined by the Vermont Department of Fish and Wildlife. No locations were identified within the study area. However, the wetland area north of the village is known to provide significant wildlife habitat functions for furbearers and migratory waterfowl.

Figure 12 shows the deer wintering areas adjacent to the East Calais Village study area, based on boundaries established by the Vermont Agency of Natural Resources. Deer wintering areas generally begin at the edge of mature coniferous tree cover. Any disturbance on identified deer wintering areas may require mitigation.



Figure 12: Deer Wintering Areas in East Calais Village Study Area



## **EAST CALAIS VILLAGE - ALTERNATIVES ANALYSIS**

Four focus areas were identified within the East Calais Village Area for evaluation. The alternatives within each focus area were developed through an examination of existing conditions as well as recommendations from state, regional, and local officials and Calais residents. The four focus areas are as follows:

1. Base Safety Improvements;
2. Sidewalks;
3. Park and Ride Lot;
4. VT 14/Marshfield Road Intersection Improvements.

The alternatives within each focus area are evaluated based on their cost, engineering elements, environmental, historic and archeological impacts, required permits, their ability to satisfy the project area Purpose and Need, and their feasibility for implementation. In the case of the first three areas, the recommendation is either a build or no-build recommendation. In the case of the VT 14-Marshfield Road intersection improvement alternatives, the recommendation is either a no-build or one of four build scenarios. Following the overview and evaluation of each of the four areas, the final portion of this section provides a recommended alternative for each focus area.

### **BASE SAFETY IMPROVEMENTS**

#### ***Base Safety Improvements - Overview***

The identified base safety improvements involve primarily short-term, low-cost operational and safety enhancements within the village that are not addressed in any of the other focus areas.

- Trim the brush and vegetation along VT 14 adjacent to Marshfield Road to improve sight distance at the VT 14-Marshfield Road intersection.
- Upgrade the advisory speed sign on VT 14 south of the VT 14-Marshfield Road intersection to improve visibility.
- Reposition the stop sign at the VT 14-Marshfield Road intersection and orient towards the Marshfield Road approach.
- Add gateway signage at entrances to the village (e.g. "Welcome to East Calais Village") to slow vehicles by alerting drivers that they are entering a village setting.
- Add a crosswalk across VT 14 linking the General Store with the parking area on the northern side of VT 14. Include appropriate pedestrian signage in advance of the crossing in both directions.
- Provide increased police speed enforcement in the village.



- Lower the posted speed on VT 14 through the village from 35 miles per hour to 30 miles per hour based on the following conditions (see Appendix L for details):
  1. Available sight distance is below the recommended standard for vehicles exiting Marshfield Road (Town Highway # 4) to VT 14 (115 feet available to 385 feet required by VT State Standards for Minor Arterials).
  2. Pedestrians must travel along the shoulders because there are no sidewalks available between the residences, store, church, and post office (located on Moscow Woods Road). Pedestrians must cross VT 14 to reach the store from on-street parking spaces located on the opposite side of the road.
  3. Driveways for single and multi-family homes and small scale commercial uses are closely spaced through the village increasing the number of conflict points within a short distance. This section of VT 14 also includes intersections with three local roads (Marshfield Road, Moscow Woods Road, and Back Street) adding additional conflict points. There are no turn lanes provided to separate through and left or right turning traffic.

Figure 13: East Calais Village - Base Safety Improvements

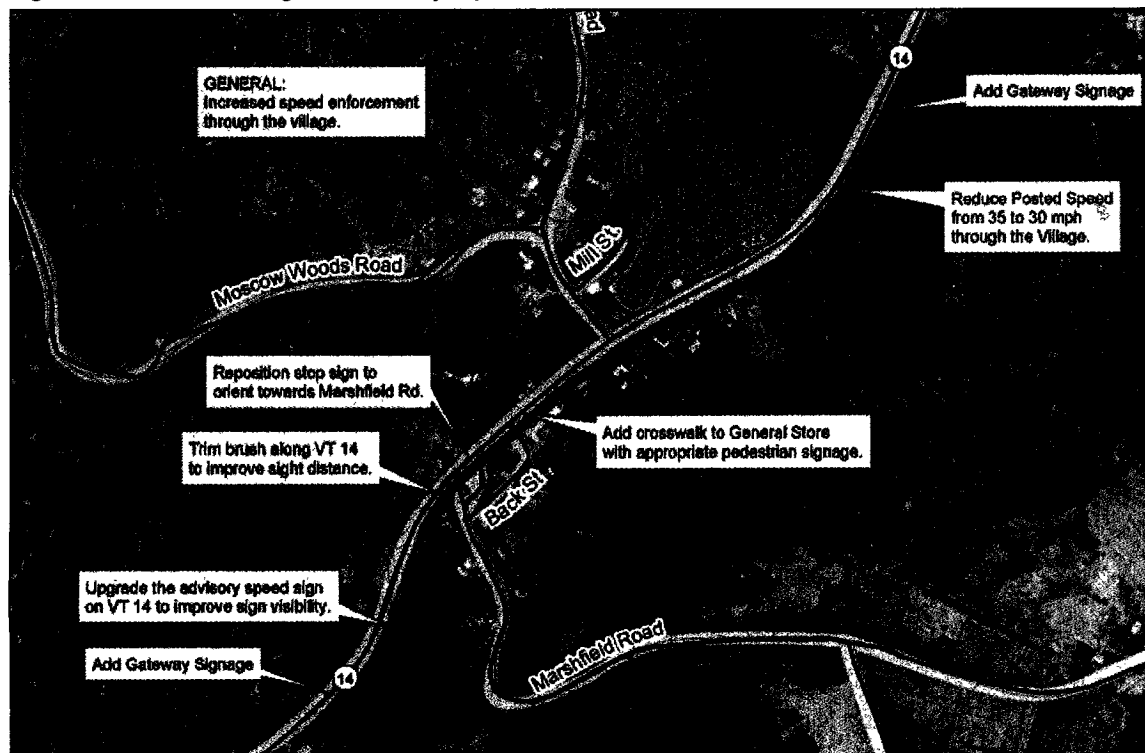


Figure 14: East Calais Village (Looking South) - Location of Proposed Crosswalk

**Base Safety Improvements - Impacts**

- Cost: The approximate cost for this alternative, which includes landscaping, new signage, a new crosswalk, and new road striping is \$9,300.
- Engineering: This alternative would improve traffic safety through brush clearing and improved signage, would improve pedestrian access through the addition of a new crosswalk.
- Impacts: No impacts identified.
- Local and Regional Issues: The new gateway signage and crosswalk would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 35 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see the following section, "Purpose and Need Matrix" for details).
- Permits: No permits identified. This alternative would be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration (See Appendix M for full text of Agreement).
- Other: A local funding match would be required for elements of this alternative.



### Base Safety Improvements - Purpose and Need Matrix

To assist in determining how closely each alternative satisfies the study area Purpose and Need, we have developed the Purpose and Need Matrix shown in Table 9 below. The East Calais Village study area purpose is to *improve roadway safety and operational efficiency and to enhance multimodal transportation options throughout the defined study area*. The needs identified to achieve this goal comprise the rows of the matrix.

Each of the alternatives (in this case, “No Build” vs. “Base Safety Improvements”) is given a rating of “not met”, “partially met”, or “fully met” with respect to each of the study area needs. A “not met” rank is given 0 points, a “partially met” rank is given 5 points, and a “fully met” rank is given 10 points. The total points for each alternative is summed and shown at the bottom of the table. The maximum score is 90 points.

The No Build Scenario, which satisfies none of the identified needs scores 0 points. The Base Safety Improvements alternative scores a total of 35 points for improved safety at the VT 14-Marshfield Road intersection, slowing speeds in the village, and providing a crosswalk across VT 14 to the General Store.

**Table 9: Base Safety Improvements - Purpose and Need Evaluation Matrix**

Needs	Alternative 1 Do Nothing	Alternative 2 Base Improvements
<b>Safety</b>		
Improve sight distance at the VT 14-Marshfield Road intersection	○	⊙
Eliminate conflicts between pedestrians and vehicles (especially trucks)	○	⊙
Slow speeds through East Calais Village	○	●
Re-align stop sign at VT 14-Marshfield Road intersection	○	●
<b>Operational Inefficiencies</b>		
Eliminate confusing and awkward configuration at VT 14-Marshfield Road intersection	○	○
If Back Street is intended to carry more volume, pave and provide adequate width, shoulders, and sidewalks.	○	○
Provide additional parking for General Store	○	○
<b>Lack of Multimodal Transportation Options</b>		
Provide sidewalks and crosswalks at appropriate places in the Village	○	⊙
Provide a Park and Ride facility	○	○
<div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="border: 1px solid black; padding: 5px; width: 150px;"> <p>○ Not Met</p> <p>⊙ Partially Met</p> <p>● Fully Met</p> </div> <div> <p>Not Met      9      4</p> <p>Partially Met      0      3</p> <p>Fully Met      0      2</p> <p><b>TOTAL</b>      <b>0</b>      <b>35</b></p> <p>(Out of a Total of 90)</p> </div> </div>		

### Base Safety Improvements - Evaluation Matrix

An Evaluation Matrix was developed based on the data presented above to objectively quantify and rate the No Build and the Base Safety Improvements. The matrix presents comparable results related to cost, engineering factors, impacts, local and regional issues, permits needed, and local match requirements.

The costs identified in the matrix are based on the VTrans Preliminary Engineering unit price list and other engineering cost estimation resources. The costs are order of magnitude based upon rough



estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.<sup>1</sup>

The impacts and required permits identified in the matrix are based on existing cultural, historic, archeological, and environmental data and maps as well as comments received from state and federal regulatory agencies.

**Table 10: Base Safety Improvements - Evaluation Matrix**

		<b>Alternative 1 Do Nothing</b>	<b>Alternative 2 Base Safety Improvements</b>
<b>COST</b>	Includes Engineering Costs and 50% Contingency	\$0	\$9,300
<b>ENGINEERING</b>	Traffic Safety	No Change	Improve
	Alignment Change	No Change	No
	Bicycle/Pedestrian Access	No Change	Improve
	Hydraulic Performance	No Change	No Change
<b>IMPACTS</b>	Agricultural Lands	No	No
	Archaeological	No	No
	Historic Structures/Sites	No	No
	Floodplain	No	No
	Fish and Wildlife	No	No
	Rare, Threatened & Endangered Species	No	No
	Public Lands	No	No
	Noise	No	No
	Wetlands	No	No
<b>LOCAL &amp; REGIONAL ISSUES</b>	Community Character	No Change	Improve
	Economic Impacts	No Change	Unknown
	Conformance to Regional Transportation Plan	No	Yes
	Satisfies Purpose & Need	No	35
<b>PERMITS</b>	Act 250	No	No
	401 Water Quality	No	No
	404 Corps of Engineers Permit	No	No
	Stream Alteration	No	No
	Conditional Use Determination	No	No
	Storm Water Discharge	No	No
	Shoreland Encroachment	No	No
	Endangered & Threatened Species	No	No
	State Historic Preservation Office Clearance	No	No
	NEPA: Categorical Exclusion	No	Yes
<b>OTHER</b>	Local Funding Match	No	Yes

<sup>1</sup> As the scope of this project did not allow for a detailed land survey, some of the impacts in the Evaluation Matrix have been approximated. Where a matrix element could not be defined conclusively, a conservative assumption was always made (i.e. higher cost, required permit, potential impact, etc.). A more formal investigation, involving detailed surveys will be required to determine precise implementation costs, impacts, and required permits for the selected alternative(s).



## VILLAGE SIDEWALKS

### Build Sidewalks - Overview

The Village Sidewalk element involves the construction of sidewalks along the northern side of VT 14 from the community park across from the General Store to the recreation field. A proposed alignment for the sidewalk along VT 14 was delineated and shown in Figure 15 and Figure 16 below based on available land survey data (extracted from 1946 VTrans surveys) and orthophotography.

The five-foot sidewalk is denoted in green, the state right of way is denoted in red, the edge of pavement is gray, and building footprints are tan. Based on the available survey data, it appears that the VT 14 sidewalk can remain with the State right of way along its entire length, with a break in the sidewalk along the northern side of VT 14 to allow space for six parking spaces. Crosswalks should be provided across VT 14 in front of the General Store and across Moscow Woods Road.

**Figure 15: Proposed Sidewalk Alignment - Section 1 (Community Park to Moscow Woods Road)**

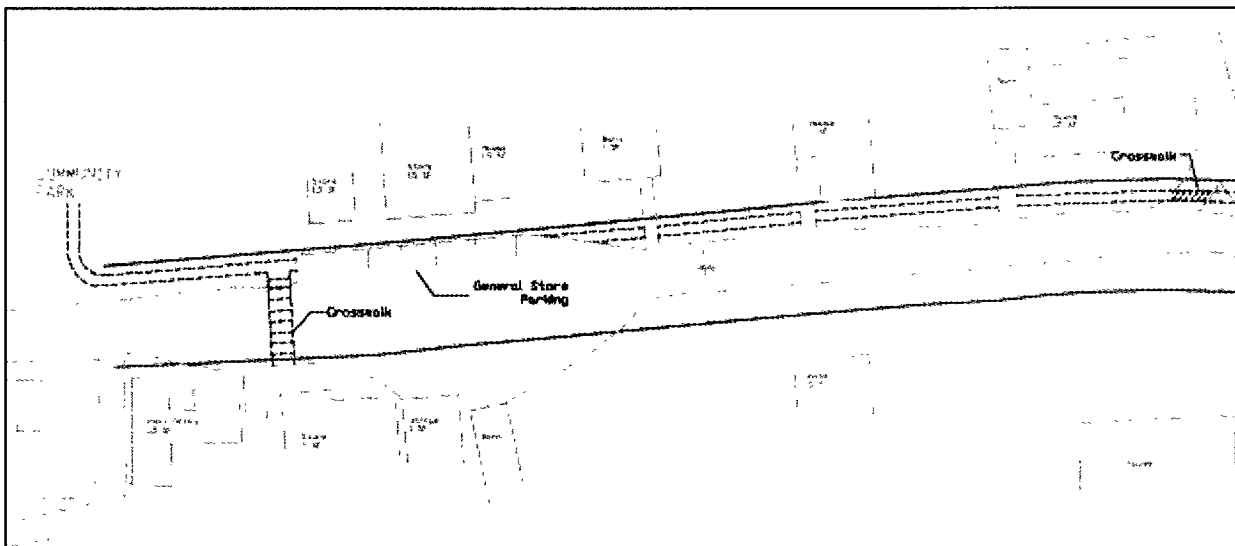
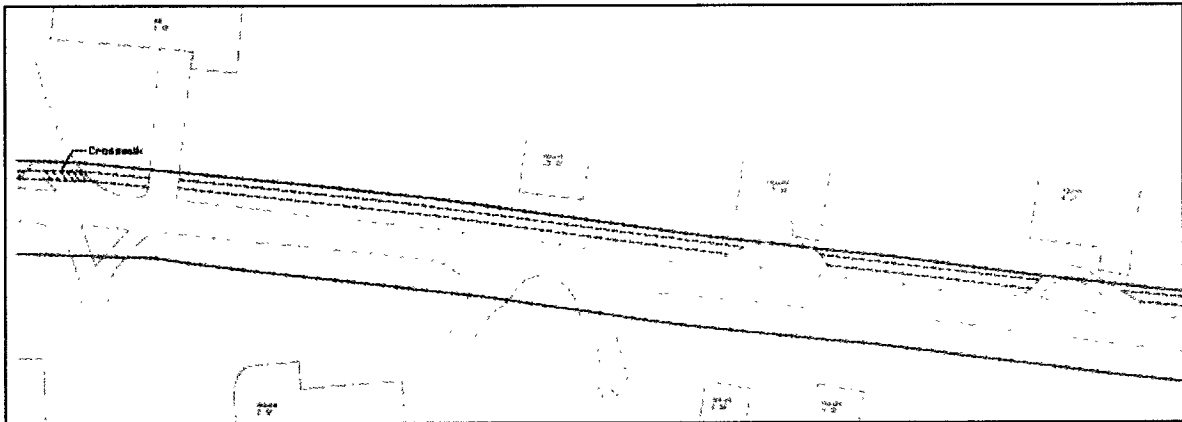




Figure 16: Proposed Sidewalk Alignment - Section 2 ( Moscow Woods Road to Village Edge)

**Build Sidewalks - Impacts**

- **Cost:** The approximate cost for the sidewalks along VT 14 from the General Store to the Recreation Fields (approximately ½ mile) is approximately \$210,000.
- **Engineering:** This alternative would improve pedestrian access through the addition of a new sidewalk and crosswalks.
- **Impacts:** The identified impacts of this alternative include potential archeological impacts associated with the new sidewalks along VT 14 and possible historic, floodplain, and wetland impacts associated with the new sidewalks along VT 14 in the village.
- **Local and Regional Issues:** The new sidewalks and crosswalks would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 15 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see the following section, "Purpose and Need Matrix" for details).
- **Permits:** The identified permits for this alternative include a 401 Water Quality permit, a 404 Corps of Engineers permit, and a Conditional Use Determination permit for the new sidewalk along VT 14 in the village, and State Historic Preservation Office Clearance for potential impacts to the designated East Calais Village Historic District. This alternative would be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration (See Appendix M for full text of Agreement)..
- **Other:** A local funding match would be required for elements of this alternative.

**Build Sidewalks - Purpose and Need Matrix**

To assist in determining how closely each alternative satisfies the study area Purpose and Need, we have developed the Purpose and Need Matrix shown in Table 11 below. The East Calais Village study area purpose is to *improve roadway safety and operational efficiency and to enhance multimodal*



*transportation options throughout the defined study area.* The needs identified to achieve this goal comprise the rows of the matrix.

Each of the alternatives (in this case, “No Build” vs. “Build Sidewalks”) is given a rating of “not met”, “partially met”, or “fully met” with respect to each of the study area needs. A “not met” rank is given 0 points, a “partially met” rank is given 5 points, and a “fully met” rank is given 10 points. The total points for each alternative is summed and shown at the bottom of the table. The maximum score is 90 points.

The No Build Scenario, which satisfies none of the identified needs scores 0 points. The Build Sidewalks alternative scores a total of 15 points for creating a safer option for pedestrian travel and for eliminating conflicts between pedestrians and vehicles through the village.

**Table 11: Build Sidewalks - Purpose and Need Evaluation Matrix**

Needs	Alternative 1 Do Nothing	Alternative 2 Sidewalks	
Safety			
Improve sight distance at the VT 14-Marshfield Road intersection	○	○	
Eliminate conflicts between pedestrians and vehicles (especially trucks)	○	●	
Slow speeds through East Calais Village	○	○	
Re-align stop sign at VT 14-Marshfield Road intersection	○	○	
Operational Inefficiencies			
Eliminate confusing and awkward configuration at VT 14-Marshfield Road intersection	○	○	
If Back Street is intended to carry more volume, pave and provide adequate width, shoulders, and sidewalks.	○	○	
Provide additional parking for General Store	○	○	
Lack of Multimodal Transportation Options			
Provide sidewalks and crosswalks at appropriate places in the Village	○	⊙	
Provide a Park and Ride facility	○	○	
<div><div>○ Not Met</div><div>⊙ Partially Met</div><div>● Fully Met</div></div>	Not Met	9	7
	Partially Met	0	1
	Fully Met	0	1
	TOTAL	0	15
	(Out of a Total of 90)		

### **Build Sidewalks - Evaluation Matrix**

An Evaluation Matrix was developed based on the data presented above to objectively quantify and rate the No Build and the Build Sidewalks alternative. The matrix presents comparable results related to cost, engineering factors, impacts, local and regional issues, permits needed, and local match requirements.

The costs identified in the matrix are based on the VTrans Preliminary Engineering unit price list and other engineering cost estimation resources. The costs are order of magnitude based upon rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.<sup>1</sup>

<sup>1</sup> As the scope of this project did not allow for a detailed land survey, some of the impacts in the Evaluation Matrix have been approximated. Where a matrix element could not be defined conclusively, a conservative assumption was always made (i.e.



The impacts and required permits identified in the matrix are based on existing cultural, historic, archeological, and environmental data and maps as well as comments received from state and federal regulatory agencies.

**Table 12: Build Sidewalks - Evaluation Matrix**

		Alternative 1 Do Nothing	Alternative 2 VT 14 Sidewalks
<b>COST</b>	Includes Engineering Costs and 50% Contingency	\$0	\$210,000
<b>ENGINEERING</b>	Traffic Safety	No Change	Improve
	Alignment Change	No Change	No
	Bicycle/Pedestrian Access	No Change	Improve
	Hydraulic Performance	No Change	No Change
<b>IMPACTS</b>	Agricultural Lands	No	No
	Archaeological	No	Possible
	Historic Structures/Sites	No	Possible
	Floodplain	No	Possible
	Fish and Wildlife	No	No
	Rare, Threatened & Endangered Species	No	No
	Public Lands	No	No
	Noise	No	No
	Wetlands	No	Possible
<b>LOCAL &amp; REGIONAL ISSUES</b>	Community Character	No Change	Improve
	Economic Impacts	No Change	Improve
	Conformance to Regional Transportation Plan	No	Yes
	Satisfies Purpose & Need	No	15
<b>PERMITS</b>	Act 250	No	No
	401 Water Quality	No	Possible
	404 Corps of Engineers Permit	No	Possible
	Stream Alteration	No	No
	Conditional Use Determination	No	Possible
	Storm Water Discharge	No	No
	Shoreland Encroachment	No	No
	Endangered & Threatened Species	No	No
	State Historic Preservation Office Clearance	No	Possible (Village Designated Historic District)
	NEPA: Categorical Exclusion	No	Yes
<b>OTHER</b>	Local Funding Match	No	Yes

## PARK AND RIDE FACILITY

### *Park and Ride - Overview*

A park and ride facility would allow for commuters in and around Calais who are interested in carpooling to leave their cars at a central location and share a ride to work or any other common

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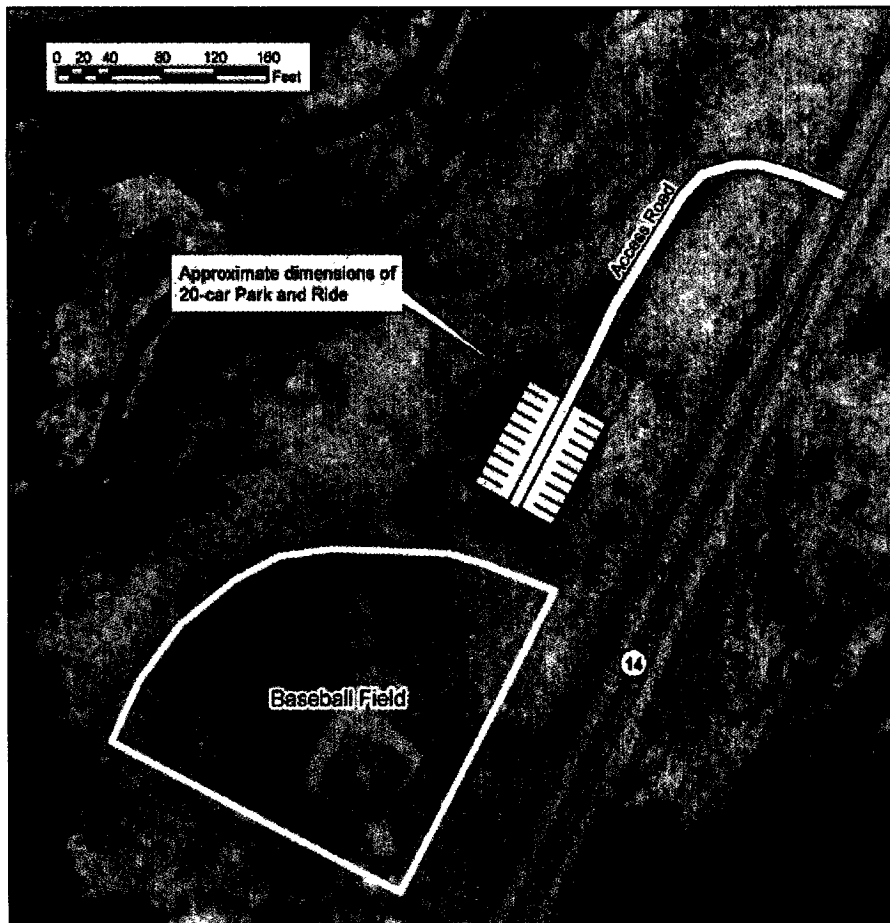
higher cost, required permit, potential impact, etc.). A more formal investigation, involving detailed surveys will be required to determine precise implementation costs, impacts, and required permits for the selected alternative(s).



destination. As part of this analysis a 20-car park and ride lot adjacent to the existing baseball field located north of East Calais Village off of VT 14 has been assumed.

Figure 17 shows a conceptual layout of the park and ride lot with the approximate dimensions of the paved or gravel parking area shown in yellow. The lot would include adequate lighting for security as well as pavement marking and new signage. During off-commute hours, the lot could be used for parking for events at the recreation field.

Figure 17: Conceptual Layout of Park and Ride Lot



#### **Park and Ride - Impacts**

- **Cost:** The approximate cost for the park and ride facility, including pavement overlay, lighting, pavement striping, and signage is approximately \$220,000.
- **Engineering:** This alternative would improve multimodal accessibility through the addition of a new park and ride lot.



- Impacts: The identified impacts of this alternative include potential archeological impacts associated with the new park and ride lot.
- Local and Regional Issues: The new park and ride lot would improve community character and conforms to the Regional Transportation Plan. This alternative scores 10 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see the following section, "Purpose and Need Matrix" for details).
- Permits: The identified permits for this alternative include a Storm Water Discharge permit for the new park and ride lot. This alternative would be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration (See Appendix M for full text of Agreement).
- Other: A local funding match would be required for the park and ride lot.

#### **Park and Ride - Purpose and Need Matrix**

To assist in determining how closely each alternative satisfies the study area Purpose and Need, we have developed the Purpose and Need Matrix shown in Table 13 below. The East Calais Village study area purpose is to *improve roadway safety and operational efficiency and to enhance multimodal transportation options throughout the defined study area*. The needs identified to achieve this goal comprise the rows of the matrix.

Each of the alternatives (in this case, "No Build" vs. "Build Park and Ride") is given a rating of "not met", "partially met", or "fully met" with respect to each of the study area needs. A "not met" rank is given 0 points, a "partially met" rank is given 5 points, and a "fully met" rank is given 10 points. The total points for each alternative is summed and shown at the bottom of the table. The maximum score is 90 points.

The No Build Scenario, which satisfies none of the identified needs scores 0 points. The Build Park and Ride alternative scores a total of 10 points for increasing multimodal travel options through the provision of a park and ride facility.



Table 13: Park and Ride - Purpose and Need Evaluation Matrix

Needs	Alternative 1 Do Nothing	Alternative 2 Park and Ride
<b>Safety</b>		
Improve sight distance at the VT 14-Marshfield Road intersection	○	○
Eliminate conflicts between pedestrians and vehicles (especially trucks)	○	○
Slow speeds through East Calais Village	○	○
Re-align stop sign at VT 14-Marshfield Road intersection	○	○
<b>Operational Inefficiencies</b>		
Eliminate confusing and awkward configuration at VT 14-Marshfield Road intersection	○	○
If Back Street is intended to carry more volume, pave and provide adequate width, shoulders, and sidewalks.	○	○
Provide additional parking for General Store	○	○
<b>Lack of Multimodal Transportation Options</b>		
Provide sidewalks and crosswalks at appropriate places in the Village	○	○
Provide a Park and Ride facility	○	●
	Not Met 9	10
	Partially Met 0	0
	Fully Met 0	1
	<b>TOTAL</b> 0	<b>10</b>
(Out of a Total of 90)		

- Not Met  
 ◎ Partially Met  
 ● Fully Met

### Park and Ride - Evaluation Matrix

An Evaluation Matrix was developed based on the data presented above to objectively quantify and rate the No Build and the Build Park and Ride alternative. The matrix presents comparable results related to cost, engineering factors, impacts, local and regional issues, permits needed, and local match requirements.

The costs identified in the matrix are based on the VTrans Preliminary Engineering unit price list and other engineering cost estimation resources. The costs are order of magnitude based upon rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.<sup>1</sup>

The impacts and required permits identified in the matrix are based on existing cultural, historic, archeological, and environmental data and maps as well as comments received from state and federal regulatory agencies.

<sup>1</sup> As the scope of this project did not allow for a detailed land survey, some of the impacts in the Evaluation Matrix have been approximated. Where a matrix element could not be defined conclusively, a conservative assumption was always made (i.e. higher cost, required permit, potential impact, etc.). A more formal investigation, involving detailed surveys will be required to determine precise implementation costs, impacts, and required permits for the selected alternative(s).



Table 14: Park and Ride - Evaluation Matrix

		Alternative 1 Do Nothing	Alternative 2 Park and Ride Lot
COST	Includes Engineering Costs and 50% Contingency	\$0	\$220,000
ENGINEERING	Traffic Safety	No Change	No Change
	Alignment Change	No Change	No
	Bicycle/Pedestrian Access	No Change	No Change
	Hydraulic Performance	No Change	No Change
IMPACTS	Agricultural Lands	No	No
	Archaeological	No	Possible
	Historic Structures/Sites	No	No
	Floodplain	No	No
	Fish and Wildlife	No	No
	Rare, Threatened & Endangered Species	No	No
	Public Lands	No	No
	Noise	No	No
	Wetlands	No	No
LOCAL & REGIONAL ISSUES	Community Character	No Change	Improve
	Economic Impacts	No Change	Unknown
	Conformance to Regional Transportation Plan	No	Yes
	Satisfies Purpose & Need	No	10
PERMITS	Act 250	No	No
	401 Water Quality	No	No
	404 Corps of Engineers Permit	No	No
	Stream Alteration	No	No
	Conditional Use Determination	No	No
	Storm Water Discharge	No	Possible
	Shoreland Encroachment	No	No
	Endangered & Threatened Species	No	No
	State Historic Preservation Office Clearance	No	No
	NEPA: Categorical Exclusion	No	Yes
OTHER	Local Funding Match	No	Yes

**VT 14 – MARSHFIELD ROAD INTERSECTION IMPROVEMENTS**

The VT 14 – Marshfield Road intersection has long been identified as a confusing and potentially unsafe alignment. The lack of sight distance for vehicles turning on VT 14, the awkward alignment(s) around the church, and poorly signed movements all contribute to the confusion and potential safety problems at this intersection.

The following four alternatives have been identified for this intersection:

1. One-Way Pair (Marshfield Road & Back Street)
2. Closed Marshfield Road, Upgraded Back Street
3. Southern Marshfield Road Alignment
4. Moscow Woods Road Alignment

Each of these alternatives is analyzed in more detail below.



***One-Way Pair (Marshfield Road & Back Street) Alternative******One-Way Pair - Overview***

The One-Way Pair Alternative involves the closure of the southern section of Marshfield Road around the church and restriction of the northern portion of Marshfield Road to one-way only for traffic entering from VT 14. Back Street would be paved and serve one-way traffic heading to VT 14. See Figure 18.

***Marshfield Road:***

- Close the southern portion of Marshfield Road around the church. Use the paved area for church parking.
- Make the northern portion of Marshfield Road around the church one-way to allow vehicles to enter only from VT 14. Provide appropriate signage and striping to accommodate revised circulation pattern.
- The turning radius for a WB-50 design truck (i.e. an intermediate semi-trailer with 7.5 ft. cab and 42.5 trailer) was examined at the VT 14-Marshfield Road north access for one-way in access. It was determined that the WB-50 design vehicle could safely execute turns onto Marshfield Road from both north- and southbound VT 14 without encroaching on adjacent properties. This should be verified with more precise land survey data once available.

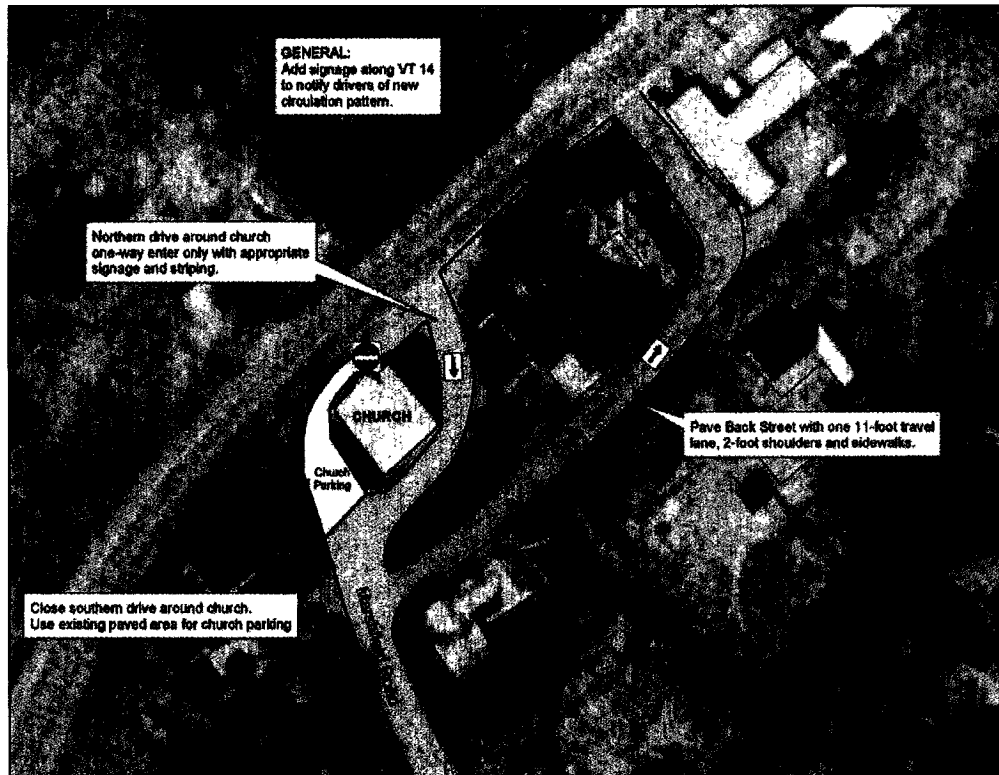
***Back Street:***

- Pave Back Street with one 11-foot travel lane, 2-foot shoulders and a 5-foot sidewalk on one side. The Vermont State Design Standards recommend a minimum 10-foot travel lane and 2-foot shoulders for village minor collectors with average traffic volumes under 1,500 cars, such as Back Street.
- Add a stop bar on Back Street adjacent to VT 14.
- Add appropriate signage along VT 14 to alert drivers to new circulation pattern.
- The turning radius for a WB-50 design truck (i.e. an intermediate semi-trailer with 7.5 ft. cab and 42.5 trailer) was examined at the VT 14-Back Street intersection for one-way out access. It was determined that the WB-50 design vehicle could safely execute turns onto VT 14 in both directions. Right turns onto VT 14 north by a WB-50 truck would encroach on southbound VT 14 lanes during part of the turning movement.





Figure 18: One Way Pair Alternative



#### One-Way Pair - Impacts

- Cost: The approximate cost for this alternative, which includes new signage, striping, closing a section of Marshfield Road, converting a portion of Marshfield Road to church parking, and widening Back Street is approximately \$83,200.
- Engineering: This alternative would improve traffic safety through improved signage and striping and improved circulation. The alternative may involve minor alignment changes along Back Street.
- Impacts: The identified impacts of this alternative include potential historic impacts associated with the widening of Back Street, and potential noise impacts along Back Street from increased traffic volume.
- Local and Regional Issues: The increased church parking would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 30 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- Permits: The identified permits for this alternative include State Historic Preservation Office Clearance for potential impacts to the designated East Calais Village Historic District with the



improvements to Back Street. This alternative may not be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration due to potential impacts to the East Calais Village Historic District from the widening of Back Street (See Appendix M for full text of Agreement).

- Other: A local funding match would be required for elements of this alternative.

Figure 19 shows a plan view of the Back Street area with a 21-foot right of way from the one-way Back Street (one 11-foot lane, two 2-foot shoulders, one 6-foot sidewalk) superimposed in orange. The existing edge of pavement is shown in red and building footprints are shown in green. The 21-foot alignment can be accommodated within the existing Back Street right-of way. A more complete survey and evaluation would be needed to be conducted to verify that there is no impact to existing buildings and yards and that enough room would be provided to adequately accommodate turns made by passenger vehicles, buses, and single-unit trucks.

Figure 19: Plan View of Back Street with 21-foot Right of Way Superimposed



***Closed Marshfield Road/Upgraded Back Street Alternative******Closed Marshfield Road/Upgraded Back Street - Overview***

The Closed Marshfield Road/Upgraded Back Street Alternative includes the complete closure of Marshfield Road access to VT 14. Traffic on Marshfield Road would be routed along a widened two-way Back Street to VT 14. See Figure 20.

***Marshfield Road:***

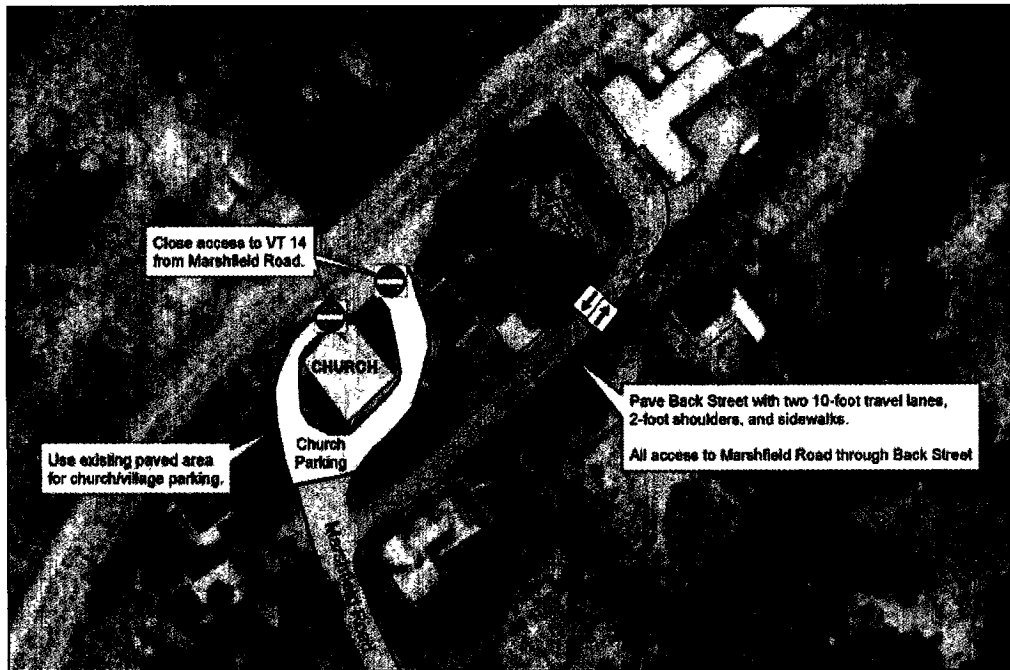
- Close access to VT 14 from Marshfield Road.
- Use existing paved area for church parking with access from Back Street and Marshfield Road

***Back Street:***

- Pave Back Street with two 10-foot travel lanes, 2-foot shoulder and a 5-foot sidewalk on one side. The Vermont State Design Standards recommend a minimum 10-foot travel lane and 2-foot shoulders for village minor collectors with average traffic volumes under 1,500 cars, such as Back Street.
- Add a stop bar on Back Street adjacent to VT 14.
- Add appropriate signage along VT 14 to alert drivers to new circulation pattern.
- The turning radius for a WB-50 design truck (i.e. an intermediate semi-trailer with 7.5 ft. cab and 42.5 trailer) was examined at the VT 14-Back Street intersection for 2-way traffic. It was determined that the WB-50 design vehicle could execute turns onto VT 14 and onto Back Street in both directions. However, potential conflicts exist for the following movements: 1) Right turns from Back Street onto VT 14 north by a WB-50 truck would encroach on southbound VT 14 lanes during part of the turning movement, and 2) Right turns from VT 14 northbound onto Back Street may encroach on adjacent property to complete the turning movement.



Figure 20: Closed Marshfield Road/Upgraded Back Street Alternative

Closed Marshfield Road/Upgraded Back Street - Impacts

- Cost: The approximate cost for this alternative which includes new signage, striping, closing access to Marshfield Road, converting a portion of Marshfield Road to church parking, and widening Back Street is \$106,900.
- Engineering: This alternative would improve traffic safety through improved signage and striping and improved circulation. The alternative may involve minor alignment changes along Back Street.
- Impacts: The identified impacts of this alternative include potential historic impacts associated with the widening of Back Street and potential noise impacts along Back Street from increased traffic volume.
- Local and Regional Issues: The increased church parking would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 40 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- Permits: The identified permits for this alternative include State Historic Preservation Office Clearance for potential impacts to the designated East Calais Village Historic District. This alternative may not be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration due to potential impacts to the East

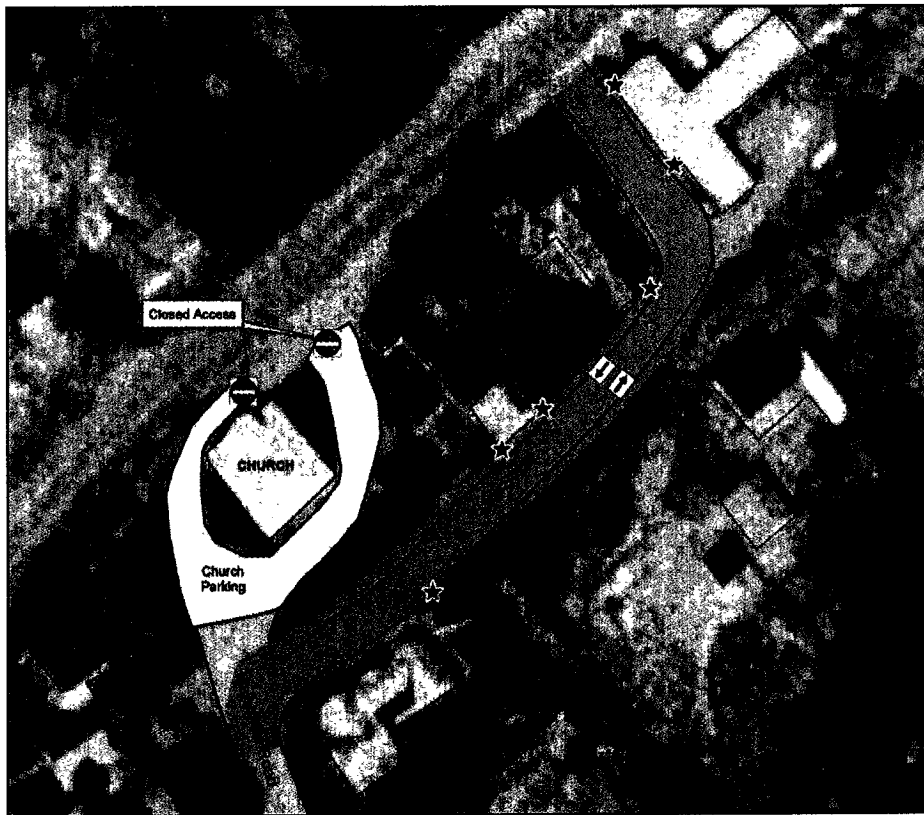


Calais Village Historic District from the widening of Back Street (See Appendix M for full text of Agreement).

- Other: A local funding match would be required for elements of this alternative.

Figure 21 shows a plan view of the Back Street area with a 30-foot right of way superimposed in orange. The existing edge of pavement is shown in red and building footprints are shown in green. The proposed traffic circulation is denoted by arrows. The figure shows significant potential impacts to adjacent buildings (shown as red stars) and limitations to truck turning movement from the two-way Back Street alternative.

Figure 21: Plan View of Back Street with 30-foot Right of Way Superimposed



### ***Southern Marshfield Road Alignment Alternative***

#### ***Southern Marshfield Road Alignment - Overview***

The Southern Marshfield Road Alignment Alternative involves the realignment of Marshfield Road to intersect with VT 14 south of the village.

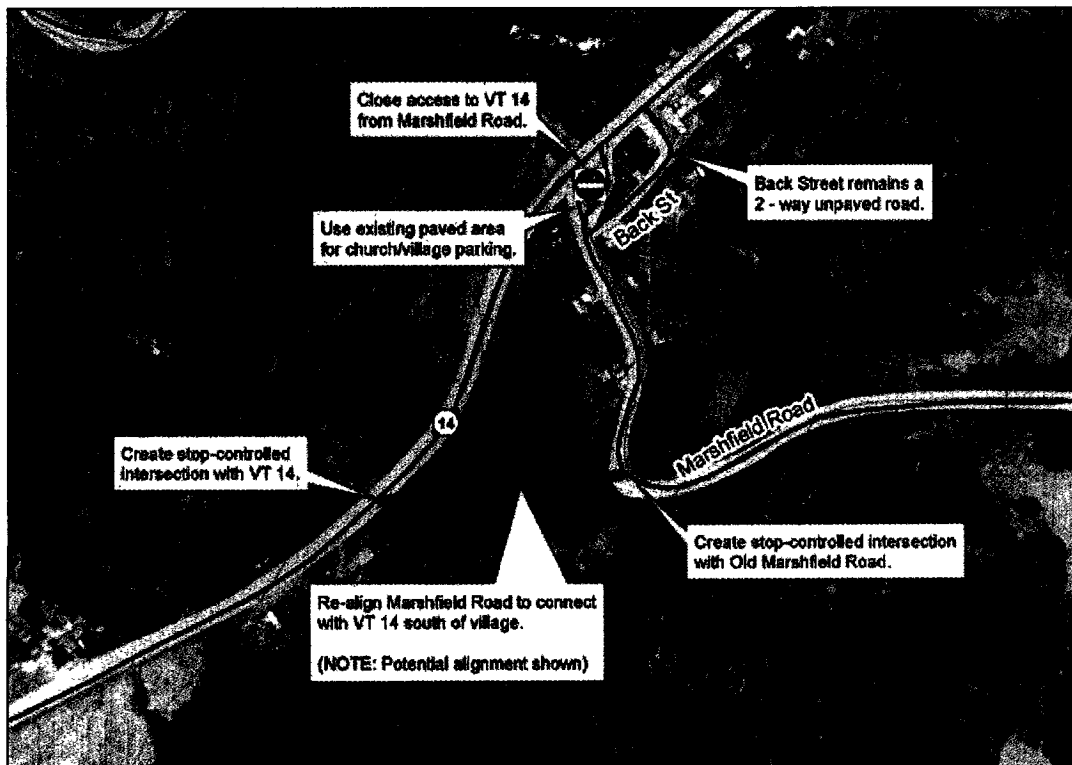
- Close the existing VT 14-Marshfield Road intersection and realign Marshfield Road to connect with VT 14 south of village. The new Marshfield Road alignment should be paved and designed



for two 11-foot lanes and 2-foot shoulders on each side. The Vermont State Design Standards recommend a minimum 9 foot lane and 2-foot shoulders for a rural collector such as Marshfield Road.

- The estimated slope for a proposed southern alignment would drop approximately 50 feet in 330 feet of horizontal distance, nearly a 15% average slope, which would exceed the VT State Design Standards of 9% for a rural minor collector. More detailed land survey data would be needed to confirm the maximum slope values.
- Add a stop bar on Back Street east of VT 14. Back Street remains an unpaved 2-way road.
- Add appropriate signage along VT 14 to alert drivers to new circulation pattern.

Figure 22: Southern Marshfield Road Alignment Alternative



#### Southern Marshfield Road Alignment - Impacts

- **Cost:** The approximate cost for this alternative which includes new signage and striping, closing access to Marshfield Road, converting a portion of Marshfield Road to church parking, and the re-alignment of Marshfield Road is approximately \$213,200.
- **Engineering:** This alternative would improve traffic safety through improved signage and striping and improved circulation. The alternative will involve an alignment change to Marshfield Road to connect with VT 14 south of East Calais Village.



- Impacts: The identified impacts of this alternative include potential noise impacts along the new Marshfield Road alignment and potential wetlands impacts associated with the new Marshfield Road alignment near VT 14.
- Local and Regional Issues: The increased church parking would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 35 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- Permits: The identified permits for this alternative include a 401 Water Quality permit, a 404 Corps of Engineers permit, and a Conditional Use Determination permit for the new Marshfield Road alignment, a Storm Water Discharge permit for the new Marshfield Road alignment, and State Historic Preservation Office Clearance for potential impacts to the designated East Calais Village Historic District. This alternative may not be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration due to potential impacts to the East Calais Village Historic District and the new alignment of Marshfield Road (See Appendix M for full text of Agreement).
- Other: A local funding match would be required for elements of this alternative.

### ***Moscow Woods Road Alignment Alternative***

#### ***Moscow Woods Road Alignment - Overview***

The Moscow Woods Road Alignment Alternative involves the construction of a new road to follow the old right of way from the VT 14-Moscow Road intersection southeast to the vicinity of the Marshfield Road-Luce Road intersection. Marshfield Road would be closed to through traffic just east of the village to only allow access for local residents from VT 14. See Figure 23.

- Construct a new road to follow old right of way from Marshfield Road-Luce Road intersection to VT 14-Moscow Road intersection. The new Marshfield Road alignment should be paved and designed for two 11-foot lanes and 2-foot shoulders on each side. This cross section satisfies the Vermont State Design Standards which recommend a minimum 9-foot lane and 2-foot shoulders for a rural collector such as Marshfield Road.
- The estimated slope for a proposed Moscow Woods Road alignment would drop approximately 150 feet in 1,450 feet of horizontal distance, a 10% average slope, which would exceed the VT State Design Standards of 9% for a rural minor collector. More detailed land survey data would be needed to confirm the maximum slope values.
- Close Marshfield Road to through traffic east of village to only allow access for local residents from VT 14.



- Add stop bar on Back Street east of VT 14. Back Street remains a 2-way unpaved road with its existing cross-section.
- Add appropriate signage along VT 14 to alert drivers to new circulation pattern.

Figure 23: Moscow Woods Road Alignment Alternative

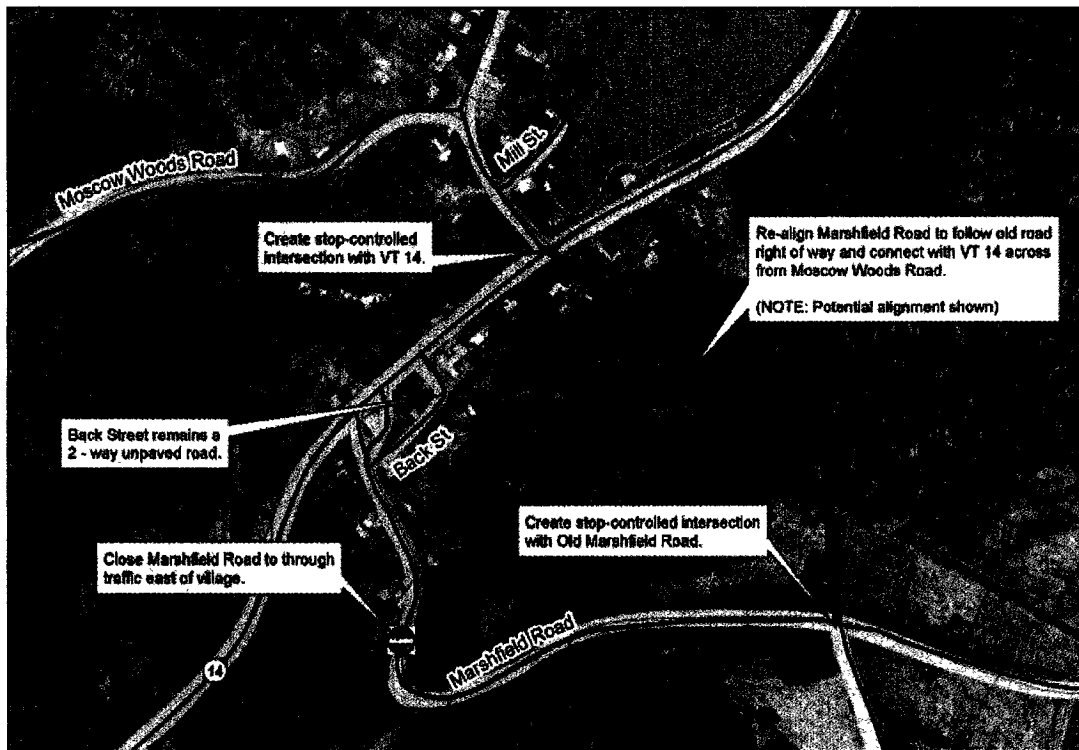
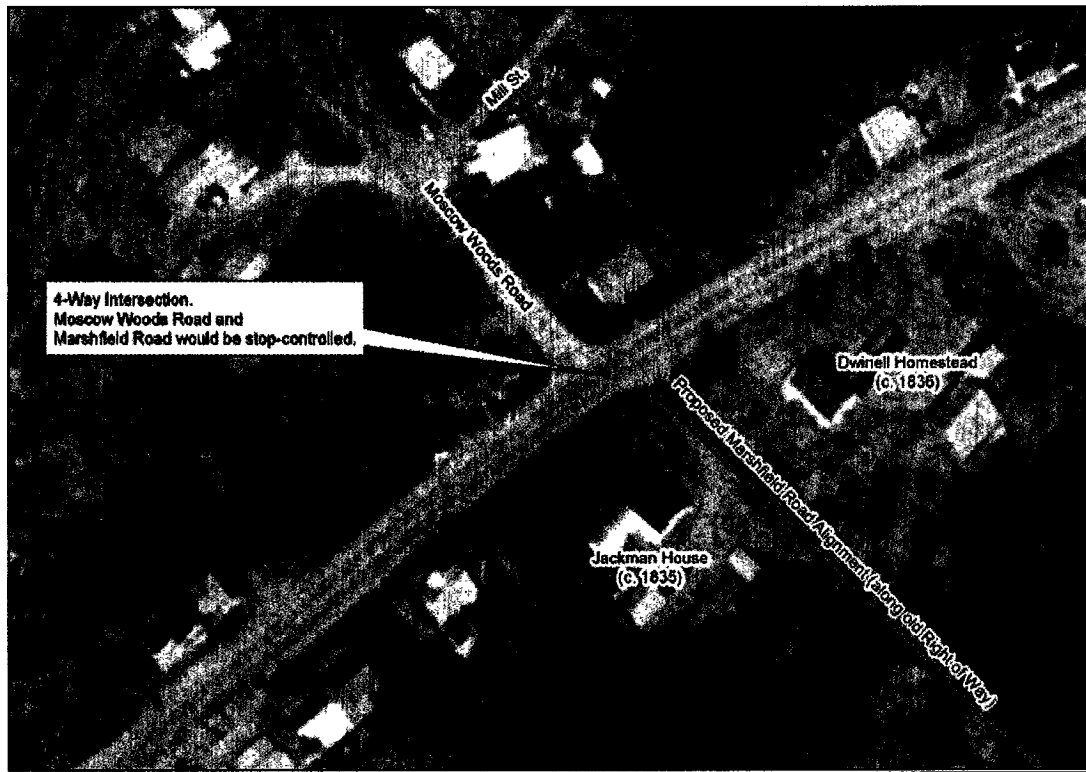


Figure 24 shows a close-up of the proposed intersection of VT 14, Moscow Woods Road, and the re-aligned Marshfield Road noting the location of the historic Jackman and Dwinell Homesteads.





Figure 24: East Calais Village – Realigned Marshfield Road Intersection with VT 14



#### Moscow Woods Road Alignment - Impacts

- Cost: The approximate cost for this alternative which includes new signage and striping, closing access to Marshfield Road, converting a portion of Marshfield Road to church parking, and realignment of Marshfield Road is approximately \$541,400. This is the most expensive of the six alternatives.
- Engineering: This alternative would improve traffic safety through improved signage and striping and improved circulation. The alternative will involve an alignment change to Marshfield Road to connect with VT 14 across from Moscow Woods Road.
- Impacts: The identified impacts of this alternative include potential historic impacts associated with the new Marshfield Road alignment and potential noise impacts along the new Marshfield Road alignment.
- Local and Regional Issues: The increased church parking would improve community character. The elements of this alternative conform to the Regional Transportation Plan. This alternative scores 35 points out of a possible 90 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).



- Permits: The identified permits for this alternative include a Storm Water Discharge permit for the new Marshfield Road alignment and State Historic Preservation Office Clearance for potential impacts to the designated East Calais Village Historic District. This alternative may not be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration due to potential impacts to the East Calais Village Historic District and the new alignment of Marshfield Road (See Appendix M for full text of Agreement).
- Other: A local funding match would be required for elements of this alternative.

#### VT 14 – Marshfield Road Intersection Alternatives - Purpose and Need Matrix

To assist in determining how closely each Marshfield Road alternative satisfies the study area Purpose and Need, we have developed the Purpose and Need Matrix shown in Table 15 below. The East Calais Village study area purpose is to *improve roadway safety and operational efficiency and to enhance multimodal transportation options throughout the defined study area*. The needs identified to achieve this goal comprise the rows of the matrix.

Each of the alternatives is given a rating of “not met”, “partially met”, or “fully met” with respect to each of the study area needs. A “not met” rank is given 0 points, a “partially met” rank is given 5 points, and a “fully met” rank is given 10 points. The total points for each alternative is summed and shown at the bottom of the table. The maximum score is 90 points.

Alternative 1, which involves no improvements scores the lowest with 0 points. Alternative 3, the Closed Marshfield Road/Upgraded Back Street scores the highest with 40 points.

**Table 15: VT 14-Marshfield Road Intersection Alternatives - Purpose and Need Evaluation Matrix**

Needs	Alternative 1 Do Nothing	Alternative 2 One-Way Pair	Alternative 3 Closed Marshfield Road - Upgraded Back Street	Alternative 4 Southern Marshfield Road Alignment	Alternative 5 Moscow Woods Road Alignment
<b>Safety</b>					
Improve sight distance at the VT 14-Marshfield Road intersection	○	⊙	●	●	●
Eliminate conflicts between pedestrians and vehicles (especially trucks)	○	○	○	○	○
Slow speeds through East Calais Village	○	○	○	○	○
Re-align stop sign at VT 14-Marshfield Road intersection	○	●	●	●	●
<b>Operational Inefficiencies</b>					
Eliminate confusing and awkward configuration at VT 14-Marshfield Road intersection	○	⊙	●	●	●
If Back Street is intended to carry more volume, pave and provide adequate width, shoulders, and sidewalks.	○	●	●	⊙	⊙
Provide additional parking for General Store	○	○	○	○	○
<b>Lack of Multimodal Transportation Options</b>					
Provide sidewalks and crosswalks at appropriate places in the Village	○	○	○	○	○
Provide a Park and Ride facility	○	○	○	○	○
	Not Met	5	5	5	5
	Partially Met	0	0	1	1
	Fully Met	2	4	3	3
	<b>TOTAL</b>	<b>0</b>	<b>40</b>	<b>35</b>	<b>35</b>
	(Out of a Total of 90)				

○ Not Met  
 ⊙ Partially Met  
 ● Fully Met



**VT 14 – Marshfield Road Intersection Alternatives - Evaluation Matrix**

An Evaluation Matrix was developed based on the data presented above to objectively quantify and rate the five alternatives identified to improve the VT 14-Marshfield Road intersection. The matrix presents comparable results related to cost, engineering factors, impacts, local and regional issues, permits needed, and local match requirements.

The costs identified in the matrix are based on the VTrans Preliminary Engineering unit price list and other engineering cost estimation resources. The costs are order of magnitude based upon rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.<sup>1</sup>

The impacts and required permits identified in the matrix are based on existing cultural, historic, archeological, and environmental data and maps as well as comments received from state and federal regulatory agencies.

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<sup>1</sup> As the scope of this project did not allow for a detailed land survey, some of the impacts in the Evaluation Matrix have been approximated. Where a matrix element could not be defined conclusively, a conservative assumption was always made (i.e. higher cost, required permit, potential impact, etc.). A more formal investigation, involving detailed surveys will be required to determine precise implementation costs, impacts, and required permits for the selected alternative(s).



Table 16: VT 14-Marshfield Road Intersection Alternatives - Evaluation Matrix

		Alternative 1 Do Nothing	Alternative 2 One-Way Pair	Alternative 3 Closed Marshfield Road - Upgraded Back Street	Alternative 4 Southern Marshfield Road Alignment	Alternative 5 Moscow Woods Road Alignment
COST	Includes Engineering Costs and 50% Contingency	\$0	\$83,200	\$106,900	\$213,200	\$541,400
ENGINEERING	Traffic Safety	No Change	Improve	Improve	Improve	Improve
	Alignment Change	No Change	Yes	Yes	Yes	Yes
	Bicycle/Pedestrian Access	No Change	No Change	No Change	No Change	No Change
	Hydraulic Performance	No Change	No Change	No Change	No Change	No Change
IMPACTS	Agricultural Lands	No	No	No	No	No
	Archaeological	No	No	No	No	No
	Historic Structures/Sites	No	No	No	No	Possible (Dwinnell Homestead)
	Floodplain	No	No	No	No	No
	Fish and Wildlife	No	No	No	No	No
	Rare, Threatened & Endangered Species	No	No	No	No	No
	Public Lands	No	No	No	No	No
	Noise	No	Yes (Increase along Back Street)	Yes (Increase along Back Street)	Yes (Increase along new alignment)	Yes (Increase along new alignment)
	Wetlands	No	No	No	Possible (New Alignment)	No
LOCAL & REGIONAL ISSUES	Community Character	No Change	Improve	Improve	Improve	Improve
	Economic Impacts	No Change	Unknown	Unknown	Unknown	Unknown
	Conformance to Regional Transportation Plan	No	Yes	Yes	Yes	Yes
	Satisfies Purpose & Need	No	30	40	35	35
PERMITS	Act 250	No	No	No	No	No
	401 Water Quality	No	No	No	Possible (New Alignment)	No
	404 Corps of Engineers Permit	No	No	No	Possible (New Alignment)	No
	Stream Alteration	No	No	No	No	No
	Conditional Use Determination	No	No	No	Possible (New Alignment)	No
	Storm Water Discharge	No	No	No	Possible (New Alignment)	Possible (New Alignment)
	Shoreland Encroachment	No	No	No	No	No
	Endangered & Threatened Species	No	No	No	No	No
	State Historic Preservation Office Clearance	No	Possible (Village Designated Historic District)	Possible (Village Designated Historic District)	Possible (Village Designated Historic District)	Possible (Village Designated Historic District)
	NEPA: Categorical Exclusion	No	Possible (Historic District Impact)	Possible (Historic District Impact)	Possible (New Alignment)	Possible (New Alignment)
OTHER	Local Funding Match	No	Yes	Yes	Yes	Yes

## SUMMARY OF RECOMMENDATIONS – EAST CALAIS VILLAGE STUDY AREA

## Overview of Findings

The preceding sections analyzed the four identified focus areas within the East Calais Village study area. These four focus areas are:

1. Base Safety Improvements
2. Sidewalks
3. Park and Ride Lot
4. VT 14/Marshfield Road Intersection Improvements

The basic elements, potential impacts, and costs for each alternative were presented and an objective evaluation was conducted to compare the alternative (or alternatives in the case of the VT 14-Marshfield Road Intersection area) against the No Build Scenario.



This section will synthesize this analysis and present a recommended alternative for each of the four focus areas.

### **Base Safety Improvements**

The base safety improvements include brush trimming to improve sight distance at the VT 14-Marshfield Road intersection, new and upgraded signage, a new crosswalk, lowered speeds in the village, and enhanced police speed enforcement. Based on this alternative's relatively low cost (\$9,300), low level of impact, ability to satisfy the study area purpose and need, and relative short timeframe in which the improvement can be implemented, as compared with the No Build alternative, it is recommended that the Base Safety Improvements alternative be implemented.

*Recommendation: Implementation of the identified Base Safety Improvements including brush trimming, new and enhance signage, a new crosswalk, lowered speed limit, and enhanced police speed enforcement for an estimated cost of \$9,300.*

### **Sidewalks**

The Village Sidewalk alternative involves the construction of sidewalks along the northern side of VT 14 from the community park across from the General Store to the recreation field. Based on preliminary survey and right of way information, it appears that the sidewalk could be constructed entirely within the State right of way. A village such as East Calais with a focused center containing a number of pedestrian destinations such as a general store, post office, church, a park and recreation fields, and residences could benefit from the enhanced pedestrian safety that a sidewalk could provide. The construction of the sidewalks has the potential for minor environmental and historic impacts and a relatively significant cost (\$210,000). Funding options for the sidewalk project, such as the Transportation Enhancement program, should be discussed with Regional and State officials prior to proceeding. A phased implementation may be selected in which the highest priority sections of sidewalk get constructed first.

*Recommendation: Based on the importance of a safe pedestrian network in a village setting and need expressed at the local and regional level, it is recommended that the Town move forward with engineering and construction of the sidewalks as proposed along the north side of VT 14 from the community park to the recreation field for an estimated cost of \$210,000. The Town should investigate funding options and the potential for a phased construction approach.*

### **Park and Ride**

The park and ride alternative involves the construction of a 20-car commuter park and ride lot adjacent to the baseball field on VT 14 north of East Calais Village. Based on 2000 Census data, approximately 90 Calais residents reported carpooling to work. Due to the recreation field's location in the northeastern part of Calais, we could assume that 25% of these carpoolers (23 trips) would utilize the lot. In addition to Calais residents, we can also assume that a portion of the 85 Woodbury carpoolers would utilize the lot in East Calais. Assuming that 75% of these carpool trips head past the East Calais recreation fields, we would have a total of 64 carpool trips from Woodbury. Summing



these totals together, we estimate approximately 87 carpoolers that may use this proposed lot on any given day. A relatively conservative estimate assumes that approximately half, or 40, carpoolers would utilize this lot on a given day. Since they will be carpooling, half of the 40 carpoolers would leave their car in the lot, resulting in a projected demand for 20 parking spaces.

The CVRPC Long Range Transportation Plan identifies the need for new park and ride lots at the US 2-VT 14 intersection in East Montpelier and along VT 14 in Woodbury. The above analysis shows that there is a demand for a park and ride lot in the VT 14 corridor north of East Montpelier. While the census journey to work data indicate that there is demand in this corridor for a park and ride lot, other locations in addition to the recreation field should be considered. For example, a park and lot at the town hall near Kent Corners has the advantage of being located on municipal land and is already plowed. Combining a park and ride lot at the Calais Elementary School has similar advantages and is closer to VT 14 than the town hall.

*Recommendation: Based on the potential demand for a park and ride lot along the VT 14 corridor and the relatively high cost to construct and maintain a lot, it is recommended that the recreation field location be considered and compared to other potential park and ride locations in the corridor. The comparison should consider cost, land ownership, convenience, and maintenance issues.*

#### **VT 14/Marshfield Road Intersection Improvements**

The following four alternatives were examined to address the identified problems at the VT 14-Marshfield Road intersection:

1. One-Way Pair (Marshfield Road & Back Street)
2. Closed Marshfield Road, Upgraded Back Street
3. Southern Marshfield Road Alignment
4. Moscow Woods Road Alignment

Although the Closed Marshfield Road/Upgraded Back Street alternative scored highest in the Purpose and Need evaluation and costs only slightly more than the One-Way Pair alternative with no additional impacts, the analysis showed that the 30-foot right of way needed to accommodate the two-way Back Street flow could not be constructed without significant impact to abutting properties and buildings.

Therefore, based on its ability to satisfy the identified project needs, relatively low cost (\$83,200), and minor impact, it is recommended that the One-Way Pair alternative be implemented.

*Recommendation: Alternative 1 (One-Way Pair) is recommended to address the identified VT 14-Marshfield Road intersection issues based on its relatively low cost (\$83,200), ability to satisfy project needs, and minor impact. This alternative would involve the closure of the southern section of Marshfield Road around the church and restriction of the northern portion of Marshfield Road to one-way only for traffic entering from VT 14. Back Street would be paved and serve one-way traffic heading to VT 14.*



## IMPLEMENTATION OF RECOMMENDED ELEMENTS

Figure 25 below shows the individual elements associated with each of the recommended alternatives in East Calais Village along with an estimated timeframe for implementation and an estimated cost for each element. The estimated timeframe (i.e. less than one year, between one to five years, five or more years) is based on the projected ease and number of steps required for implementation. The brush trimming along VT 14, for example, would be relatively easy to implement, requiring only town staff labor time. On the other hand, the paving and widening of Back Street could take more than five years due to potential right of way and historic impacts, time for surveys, design and engineering, and securing funding for construction.

**Figure 25: East Calais Village Implementation Schedule**

	TIMEFRAME			Estimated
	< 1 Year	1 - 5 Years	5+ Years	Cost (1)
<b>Base Safety Improvements Elements</b>				
Add gateway signage at entrances to village (e.g. "Welcome to East Calais Village")*				\$6,000
Add crosswalk across VT 14 to General Store with appropriate pedestrian signage in advance of crossing				\$1,000
Add crosswalk across Moscow Woods Road with appropriate pedestrian signage in advance of crossing				\$1,000
Trim brush along VT 14 adjacent to Marshfield Road to improve sight distance				\$1,500
Upgrade advisory speed sign on VT 14 south of the VT 14-Marshfield Road intersection to improve visibility				\$300
Pave a 15 apron and add stop bar on Back Street east of VT 14				\$500
Reduce posted speed limit on VT 14 through village from 35 mph to 30 mph				\$300
Increased police speed enforcement				N/A
<b>Sidewalks</b>				
Construct sidewalks along VT 14 from Community Park to Recreation Fields**				\$210,000
<b>Park and Ride Lot</b>				
Conduct study to further define need and location of Park and Ride lot along VT 14 to include East Calais Recreation field as alternative.***				\$220,000
<b>VT 14 - Marshfield Road (One-Way Pair Alternative)</b>				
Close the southern portion of Marshfield Road around the church. Use the paved area for church parking.^				\$12,000
Make the northern portion of Marshfield Road around the church one-way to allow vehicles to enter only from VT 14				\$300
Pave Back Street with one 11-foot travel lane, 2-foot shoulders and a 5-foot sidewalk on one side.^				\$70,000
Add appropriate signage along VT 14 to alert drivers to new circulation pattern.^				\$900
<b>Footnotes:</b>				
* Ideally, signs will be placed along state right of way or on town-owned land				
** Potential funding sources include Federal Transportation Enhancements (TE) program and Statewide Bicycle and Pedestrian program				
*** Coordinate study with VTTrans and CVRPC				
^ Determine church/town's need for additional parking capacity				
^^ Requires detailed land survey to identify land/building impacts of widening				
^^^ To be added once circulation pattern changes				
(1) The costs are order of magnitude based upon rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included				



## VT 14-LIGHTNING RIDGE ROAD-MAX GRAY ROAD INTERSECTION

*"At the Lightning Ridge Road intersection, there are poor sightlines and extra traffic owing to the presence of the elementary school."*

- Calais Town Plan-Transportation Element, 1993

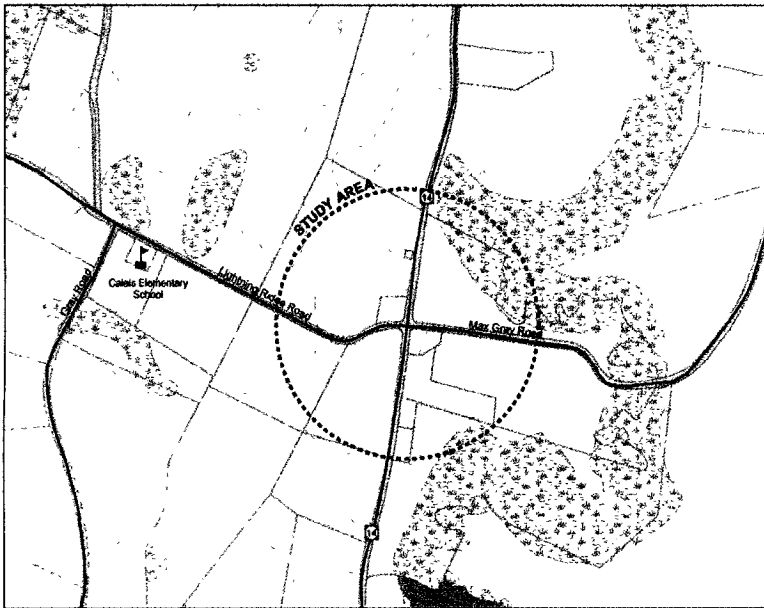
*"It is recommended that the intersection of Route 14, Lightning Ridge, and Max Gray Road be regraded and/or relocated to improve sight distance and motorist safety. The pavement condition is poor in the vicinity of this intersection."*

- Central Vermont Regional Transportation Plan, CVRPC, 2003

### PROJECT AREA

The VT 14-Lightning Ridge Road-Max Gray Road study area comprises the intersection of these roads and adjacent properties. Adjacent to the intersection are two homes on the northeast and northwest corners, respectively. Southwest of the intersection is a steeply sloping wooded parcel. Southeast of the intersection lies a flat meadow and shed.

Figure 26: VT 14-Lightning Ridge Road-Max Gray Road Study Area



### PURPOSE & NEED STATEMENT

Based on the existing and projected conditions inventoried in the study area, and comments from Calais residents and local, regional, and state officials, a purpose and need statement was developed for the VT 14-Lightning Ridge-Max Gray Road study area. The study area purpose defines the specific objectives to be addressed in the evaluation. The needs identify specific issues to be





addressed within the study area to achieve the study area purpose. The purpose and need statements help to guide the development of project area recommendations.

#### ***Study Area Purpose – VT 14-Lightning Ridge-Max Gray Road***

The purpose of this project is to improve safety at the VT 14-Lightning Ridge Road-Max Gray Road intersection.

#### ***Study Area Needs – VT 14-Lightning Ridge-Max Gray Road***

##### Safety

- Inadequate sight distance for vehicles entering and exiting the VT 14-Lightning Ridge Road-Max Gray Road intersection. This lack of sight distance is of particular concern when trucks are involved because they require longer distances to stop than passenger vehicles. Inadequate stopping distances are further affected by the heavy loads they carry on VT14 from granite quarries.
- Vehicle speeds exceed the posted speed limit on VT 14 near the intersection. These excess speeds further increase the potential for and severity of crashes.
- The Max Gray Road approach is gravel and therefore does not have a stop bar which creates a problem for driver expectations and vehicle accelerations.
- The stop sign on Lightning Ridge Road is not visible from an adequate distance for vehicles approaching VT 14.
- The Lightning Ridge Road approach with VT 14 is poorly defined, has excessive turning radii, and is not striped. As a result, vehicles are not directed to exit Lightning Ridge Road or enter from southbound VT 14 from a location where sight distance is maximized.

#### **EXISTING CONDITIONS – VT 14-LIGHTNING RIDGE ROAD-MAX GRAY ROAD**

##### ***Roadway Characteristics***

VT 14 is a rural minor arterial carrying approximately 4,000 vehicles per day through the intersection with Lightning Ridge Road and Max Gray Road. VT 14 links the Town of Calais with Montpelier, Barre and I-89 to the south and to Woodbury and Hardwick to the north. Lightning Ridge Road, a Class 3 town highway and classified as a rural local road, connects VT 14 with the East Calais Elementary School and points west. Lightning Ridge Road carries approximately 350 vehicles per day. Max Gray Road, a Class 3 town highway and classified as a rural local road, connects VT 14 with points north and east. Max Gray Road carries approximately 275 vehicles per day.

The typical cross-section of VT 14 through the study intersection includes two 12-foot lanes and 2-foot shoulders. Lightning Ridge Road has a paved surface and has a typical cross-section that includes two 11-foot lanes with no shoulders. Max Gray Road has a hard-packed gravel surface and



has a typical cross-section that includes two 11-foot lanes with no shoulders. Figure 27 compares existing conditions along these sections with established minimum design standards. The Vermont State Design Standards specify a maximum grade of 5% for a rural minor arterial with a posted speed of 50 miles per hour. As Figure 27 shows, the maximum grade on VT 14 just north of the study intersection exceeds this standard with an 8% grade. The current passing zone for southbound VT 14 traffic terminates just prior to the start of the upgrade, creating a potential safety issue due to the lack of sight distance up the hill for passing vehicles traveling on VT 14 southbound towards the Lightning Ridge Road intersection.

**Figure 27: Existing Conditions and Design Standards on VT 14 and Marshfield Road**

**VT 14 - Rural Minor Arterial**

	Design Standard*	Existing
Lane Width	> 11 ft.	12 ft.
Shoulders	> 4 ft.	2 ft.
Max. Grades	< 5%	8%
Curves **	> 760 ft.	950 ft.

**Lightning Ridge Road - Rural Local Road**

	Design Standard*	Existing
Lane Width	> 9 ft.	11 ft.
Shoulders	> 2 ft.	0 ft.

**Max Gray Road - Rural Local Road**

	Design Standard*	Existing
Lane Width	> 9 ft.	11 ft.
Shoulders	> 2 ft.	0 ft.

\* Based on VT State Design Standards, VTrans, 1997

\*\* Based on A Policy of Geometric Design of Highways and Streets, AASHTO, 2001

**Traffic**

Based on traffic counts conducted in 2003, the Average Annual Daily Traffic (AADT) volume on VT 14 in the study area is approximately 4,000 vehicles per day. The AADT on Lightning Ridge Road east of the Calais Elementary School is 345 vehicles per day, while on Max Gray Road east of VT 14 the AADT is approximately 275 vehicles per day. During the peak hours these volumes equate to roughly seven cars per minute on VT 14 and approximately one car every two minutes on Lightning Ridge Road and Max Gray Road. Table 17 below shows projected traffic volumes at these three locations for the following years: 2003, 2008, and 2013. The future year volumes are based on an average annual growth rate of 1.8%<sup>1</sup>.

In terms of the types of vehicles traveling along VT 14 in the study area, just over 92% are light-duty vehicles (i.e. passenger cars, motorcycles, pick-up trucks), 5% are medium-duty trucks (i.e. buses,

<sup>1</sup> 1.8% growth rate based on growth rate assigned to "US 2 - VT 14 North" sub-region in the 2003 Central Vermont Regional Transportation Plan, page 49.



vans, single-unit trailers) and 3% is comprised of large-duty trucks (i.e. 4 or more axle single- and multi-unit trailers). The statewide average for minor arterials such as VT 14 is 92% light-duty, 5% medium-duty, and 3% heavy duty, which is the same as the distribution on VT 14 through the study area.

Along Max Gray Road, 4% of the traffic is comprised of medium-duty trucks and 1% is comprised of large-duty trucks. Along Lightning Ridge Road, 5% of the traffic is comprised of medium-duty trucks and less than 1% is comprised of large-duty trucks. The statewide average for rural local roads (such as Max Gray Road and Lightning Ridge Road) is 95% light-duty, 4% medium-duty, and 1% large-duty. Table 17 below shows vehicle classification counts at the three study area locations.

Vehicle speeds at the three study area locations were collected in 2003 using an automatic traffic-recording unit. Table 17 shows the posted speed at the three locations along with the measured median speed and 85<sup>th</sup> percentile speed<sup>1</sup>. Despite the posted 50 mile per hour speed limit on VT 14, the 85<sup>th</sup> percentile speed is somewhat higher at 57 miles per hour. On both Lightning Ridge Road and Max Gray Road, the average traffic speeds measured fell at or below the posted speeds.

**Table 17: Volume, Vehicle Classification and Speed in the VT 14-Lightning Ridge Road Study Area**

	VT 14 north of Lightning Ridge Road	Max Gray Road - East of VT 14	Lightning Ridge Road - East of Calais Elementary School
<b>Traffic Volumes</b>			
2003 AADT	4,015	275	345
2008 AADT*	4,400	300	375
2013 AADT*	4,800	330	410
<b>Vehicle Classification</b>			
Light-Duty (Motorcycles, Cars, Pick-ups)	92%	94%	94%
Medium-Duty (Buses, Vans, Single-Unit Trailers)	5%	4%	5%
Heavy-Duty (4+ Axle Single and Multi-Unit Trailer)	3%	1%	0%
<b>Speed</b>			
Posted Speed	50 mph	35 mph	35 mph
Median Speed **	51 mph	26 mph	31 mph
85th Percentile Speed **	57 mph	31 mph	36 mph

\* Projections

\*\* Speeds measured in field

### **Intersection Capacity Analysis**

Traffic turning movement counts were conducted at the VT 14-Lightning Ridge Road-Max Gray Road intersection in 2003 during the morning and evening peak hours. The traffic count volumes were then used to conduct a capacity analysis for the intersection. Level of Service (LOS) is a qualitative measure describing the intersection operating conditions as perceived by motorists driving

<sup>1</sup> The 85<sup>th</sup> percentile speed is a commonly used traffic design and planning metric. It portrays the speed at which 85% of the measured vehicles are traveling at or below.



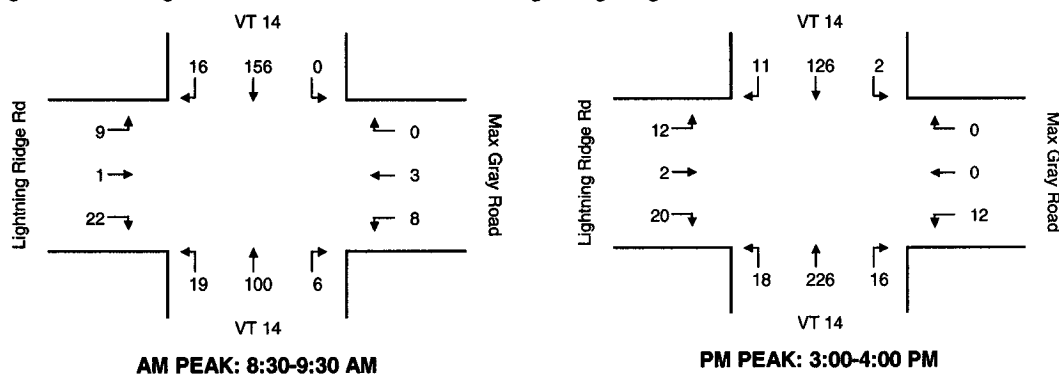
in a traffic stream, based on the average delay per vehicle. The 2000 Highway Capacity Manual defines six grades of LOS at an intersection (Table 18). The delay thresholds for levels of service at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions.

**Table 18: LOS Criteria for Signalized and Unsignalized Intersections**

LOS	Characteristics	--Unsignalized-- Total Delay (sec)	--Signalized-- Total Delay (sec)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

Figure 28 shows the design hour volumes at the VT 14 – Lightning Ridge Road intersection.

**Figure 28: Turning Movement Volumes at the VT 14-Lightning Ridge Road Intersection**



The traffic volumes were adjusted to Design Hour Volume<sup>1</sup> (DHV) conditions and used in an intersection capacity analysis. The results of the stop-controlled congestion analysis is shown below in Table 19. The analysis shows that during both the morning and evening peak, the intersection is operating well with respect to intersection capacity with only minimal delay experienced at the stop-controlled approaches. Detailed capacity analysis worksheets can be found in Appendix C.

<sup>1</sup> The design hour is defined as the 30<sup>th</sup> highest hour of traffic for a roadway within a year. It is a relatively highly congested hour of analysis, with over 99.5% of all hours in a year being less congested than the design hour.



Table 19: VT 14-Lightning Ridge Road-Max Gray Road Capacity Analysis Results

	2003			
	AM		PM	
	LOS	Delay (sec)	LOS	Delay (sec)
<b>VT 14 / Lightning Ridge Road</b>				
Eastbound Left/Through/Right, from Max Gray Rd	A	10	B	10
Westbound Left/Through/Right, from Lightning Ridge Rd	B	11	B	12
Northbound Left, from VT 14	A	8	A	9
Southbound Left, from VT 14	A	8	B	11

### Safety

Between 1990 and 2001 there were two reported accidents in the study area, both occurring at the VT 14-Lightning Ridge Road-Max Gray Road intersection (Figure 29). The first accident occurred in 1990 and was the result of a vehicle improperly passing a turning vehicle. The accident resulted in no injuries or fatalities. The second accident occurred in 1992 resulting from a head-on collision with a vehicle failing to yield right of way. The accident resulted in no injuries or fatalities. It is difficult to determine the exact cause of these accidents. However, considering the nature of this intersection, it is likely that lack of sight distance was a contributing factor.

Figure 29: Reported Accidents in the VT 14-Lightning Ridge Road Study Area (1990-2001)

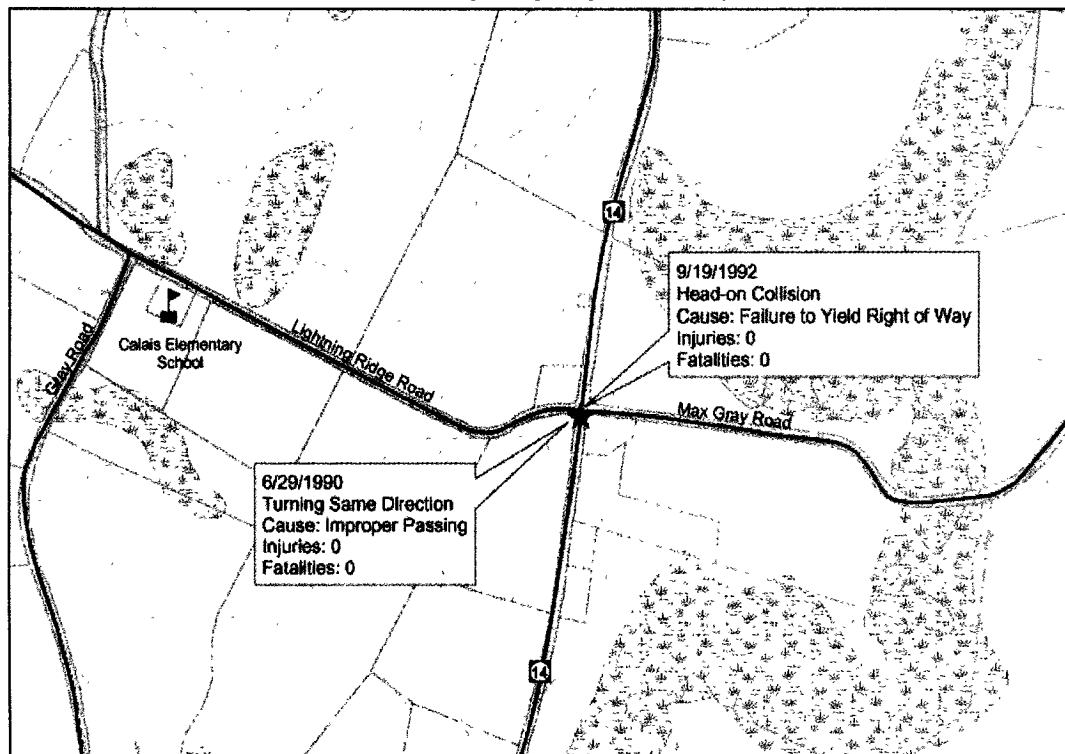


Table 20 summarizes the accident data at the VT 14-Lightning Ridge Road-Max Gray Road intersection during the twelve-year period (1990-2001). The actual-to-critical rate at the intersection in this time period is 0.375. An actual to critical rate ratio over 1.0 categorizes a High Accident



Location as defined by VTrans. The Statewide average intersection crash rate for rural arterials in this time period was 0.265.

**Table 20: VT 14-Lightning Ridge Road Intersection Accident Analysis (1990-2001)**

	Total Accidents (1990-2001)	Injuries	Actual Rate (Acc/Million Vehicle Miles)	Critical Rate (Acc/Million Vehicle Miles)	Actual/Critical Rate
VT 14-Lightning Ridge Road	2	0	0.422	1.126	0.375

### **Sight Distance**

The lack of sight distance at the VT 14-Lightning Ridge Road-Max Gray Road intersection has been acknowledged by local residents and state, regional, and local officials as an area of high concern in the study area. The posted speed on VT 14 adjacent to the intersection is 50 miles per hour, however, as the previous section noted, the majority of vehicles travel through the intersection at speeds over 55 miles per hour. In addition, the vertical curvature of VT 14 just north of the intersection provides limited sight distance for vehicles turning at the intersection.

Table 21 below shows stopping sight distances at the VT 14-Lightning Ridge Road-Max Gray Road intersection. Both stopping sight distance<sup>1</sup> and corner sight distance<sup>2</sup> were measured in the field and compared with the minimum distances recommended by the American Association of State Highway Transportation Officials (AASHTO)<sup>3</sup> based on the speed of the road being analyzed.

As Table 21 shows, both the stopping sight distance and the corner sight distance for vehicles turning out of Max Gray Road and Lightning Ridge Road are less than the AASHTO recommended minimum distances.

**Table 21: Sight Distance at the VT 14-Lightning Ridge Road-Max Gray Road Intersection**

Location	Stopping Sight Distance		Corner Sight Distance		Speed
	Field	AASHTO	Field	AASHTO	
Max Gray Road	330 ft	425 ft	160 ft	555 ft	50 mph
Lightning Ridge Road	310 ft	425 ft	215 ft	555 ft	50 mph

<sup>1</sup> Stopping sight distance refers to the minimum distance required by a vehicle traveling on the through route to see a stopped or turning vehicle and come to complete stop. It is often recommended as the minimum safe stopping sight distance at an intersection.

<sup>2</sup> Corner sight distance quantifies the distance needed for a vehicle traveling on the through route to see a turning vehicle and react such that its speed does not reduce by more than 30%.

<sup>3</sup> American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 4<sup>th</sup> Edition. Washington DC, 2001.



**Land Use**

Land use in the VT 14-Lightning Ridge Road-Max Gray Road study area is characterized by low-density residential development, forest, agricultural fields, and wetlands. One significant land use adjacent to the study area is the Calais Elementary School located on Lightning Ridge Road east of VT 14. The school includes pre-kindergarten through 6<sup>th</sup> grade and has 127 students and 34 faculty members for the 2003-04 school year. Many of the faculty, parents, and school bus routes utilize the VT 14-Lightning Ridge Road-Max Gray Road intersection to access the school.

Figure 30 shows the zoning in the VT 14-Lightning Ridge Road-Max Gray Road study area. The majority of the study area is zoned Rural Residential while the area south and east of the intersection is zoned Shoreland.

**Figure 30: VT 14-Lightning Ridge Road Study Area Zoning**

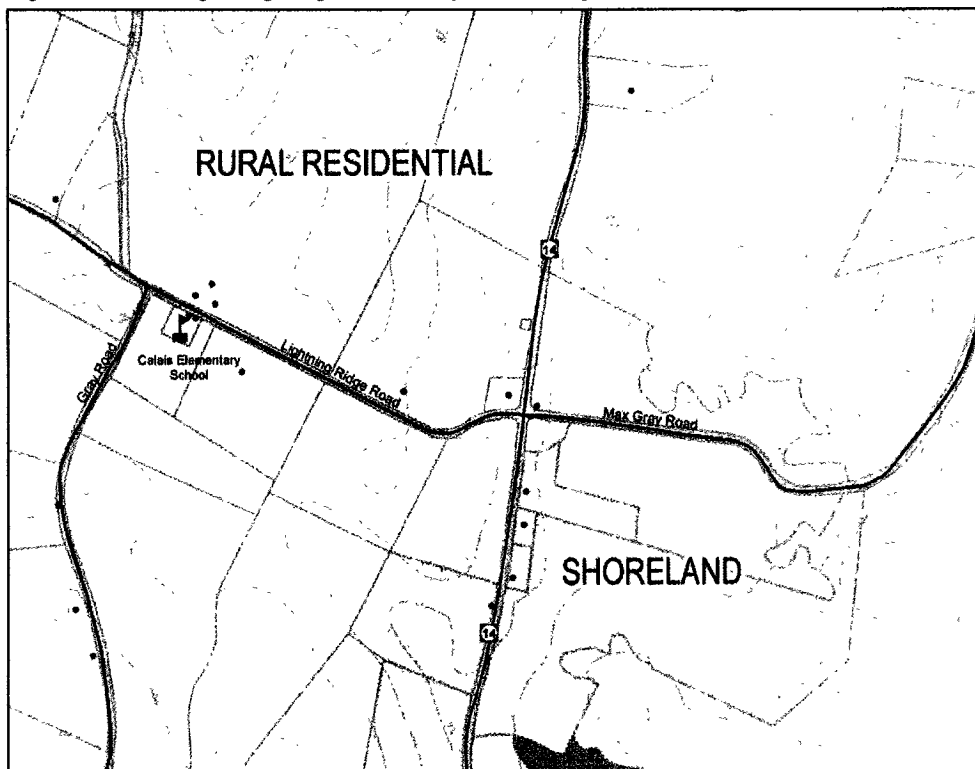


Table 22 shows the Permitted and Conditional Uses in the Rural Residential Zone.



**Table 22: Permitted and Conditional Uses in the Rural Residential Zone**

<b>Permitted Uses</b>	<b>Conditional Uses</b>
Agricultural and forestry uses	Museums
One and two family dwelling units	Theaters
Public or private outdoor recreation areas	Communities centers
Reservoirs	Religious and charitable institutions
Cemeteries	Schools
Professional residence offices	Mobile home parks
Public utility facilities	Bed and breakfasts
Home occupations	Restaurants
	Resource extraction areas
	Commercial and light industrial uses
	Major subdivisions

Table 23 shows the Permitted and Conditional Uses in the Shoreland Zone.

**Table 23: Permitted and Conditional Uses in the Shoreland Zone**

<b>Permitted Uses</b>	<b>Conditional Uses</b>
Agricultural and forestry uses	Commercial outdoor recreation
One and two family dwelling units	Resource extraction areas
Public or private outdoor recreation areas	Bed and breakfasts
Reservoirs	Major subdivisions
Public utility facilities	Home industry
Professional residence offices	
Home occupations	

### ***Resources – Historic***

A preliminary historic assessment of East Calais Village was conducted in the Fall of 2003 by Hartgen Archeological Associates, Inc. Information from this assessment was supplement with information from the Vermont Division for Historic Preservation.

There are two historical items of note in the VT 14-Lightning Ridge Road-Max Gray Road study area. The first is the house located on the northeast corner of the intersection which was constructed in 1873. The second is the remains of a 19<sup>th</sup> century schoolhouse located southwest of the study intersection.

### ***Resources - Archeological***

A complete archeological assessment was conducted in the Fall of 2003 by Hartgen Archeological Associates, Inc. Their review of the Vermont Archeological Inventory (VAI) and town files revealed no reported archeological sites within 1 mile of the project area. However, the proximity of the study area to the Kingsbury Branch may have attracted early settlers and thus, the potential for precontact archeological deposits exists in the study area.

The Environmental Predictive Model for Location Precontact Archeological Sites analysis, as defined by the Vermont Division for Historic Preservation (VDHP), was conducted for the study areas. The analysis quantifies the potential for precontact archeological sites in the study areas. A score of 32 or greater indicates archeological sensitivity. Based on the analysis conducted for this report, the study areas yielded a sensitivity rating of 56.



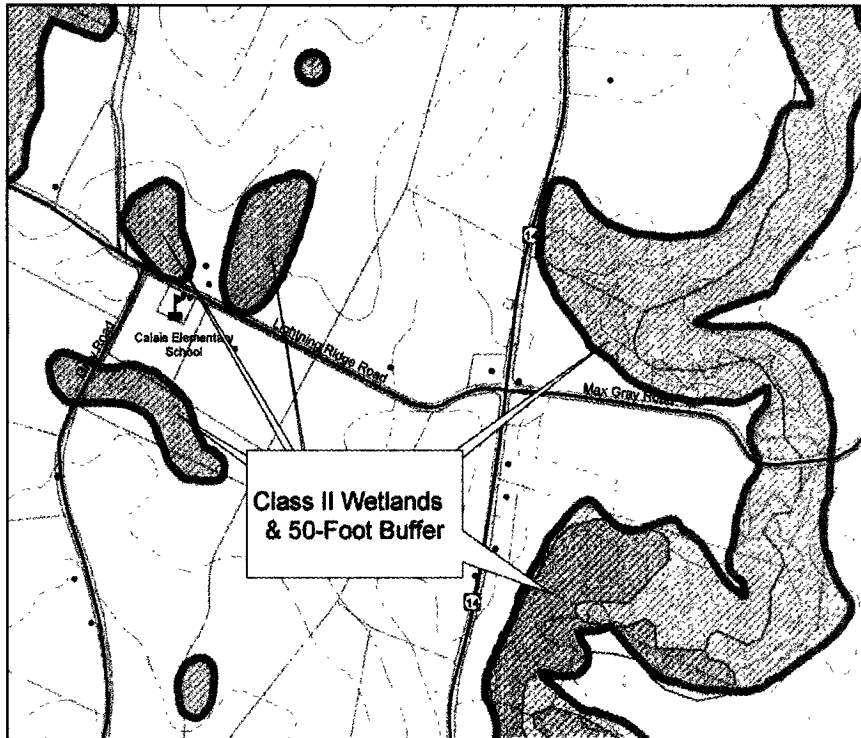


A complete archeological assessment can be found in Appendix G.

### **Resources – Wetlands**

Figure 31 shows the extent of Class II wetlands in the VT 14-Lightning Ridge Road study area. The wetland boundaries are based on the Vermont Significant Wetlands Inventory developed by the Vermont Agency of Natural Resources. Class II wetlands, including a 50-foot protective buffer, are protected under the Vermont Wetland Rules. Any intrusion into the identified wetland or its buffer requires a Conditional Use Determination from the Water Quality Division of the Department of Environmental Conservation. The 50-foot buffer approaches closest to the study area along Max Gray Road east of VT 14 and near VT 14 north of the study area.

**Figure 31: Class II Wetlands and 50-Foot Buffer in VT 14-Lightning Ridge Road Study Area**



### **Resources – Flood Plains**

Figure 32 shows the identified floodplain areas in the VT 14-Lightning Ridge Road study area as identified by the Federal Emergency Management Agency (FEMA). The figure identifies the 100-year floodplain along the Kingsbury Branch of the Winooski River. The identified 100-year floodplain lies on both sides of Max Gray Road east of VT 14.



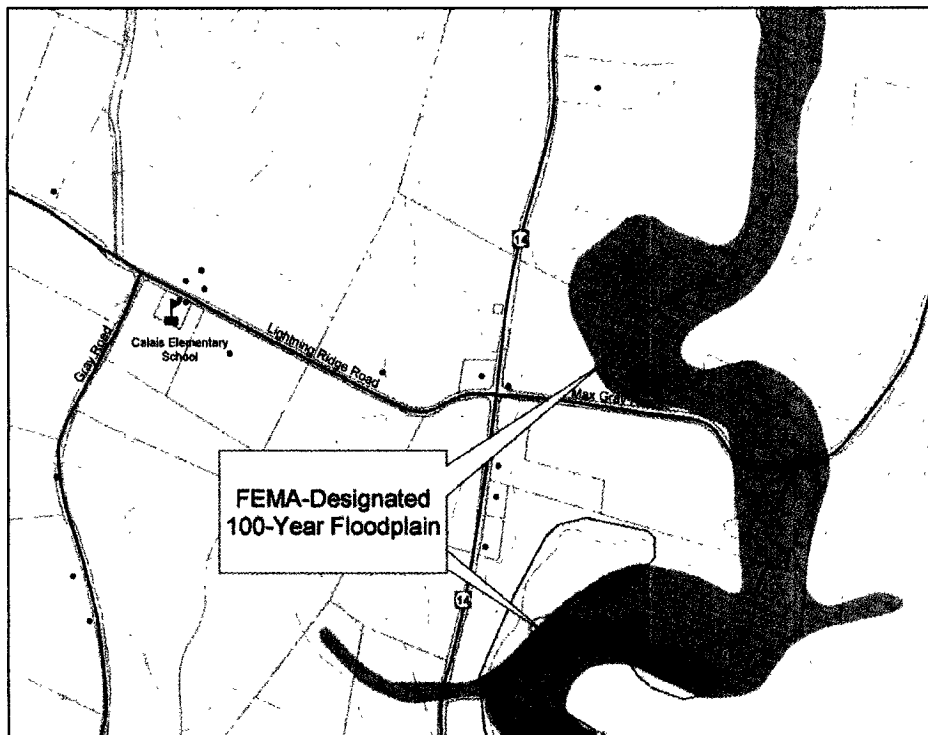
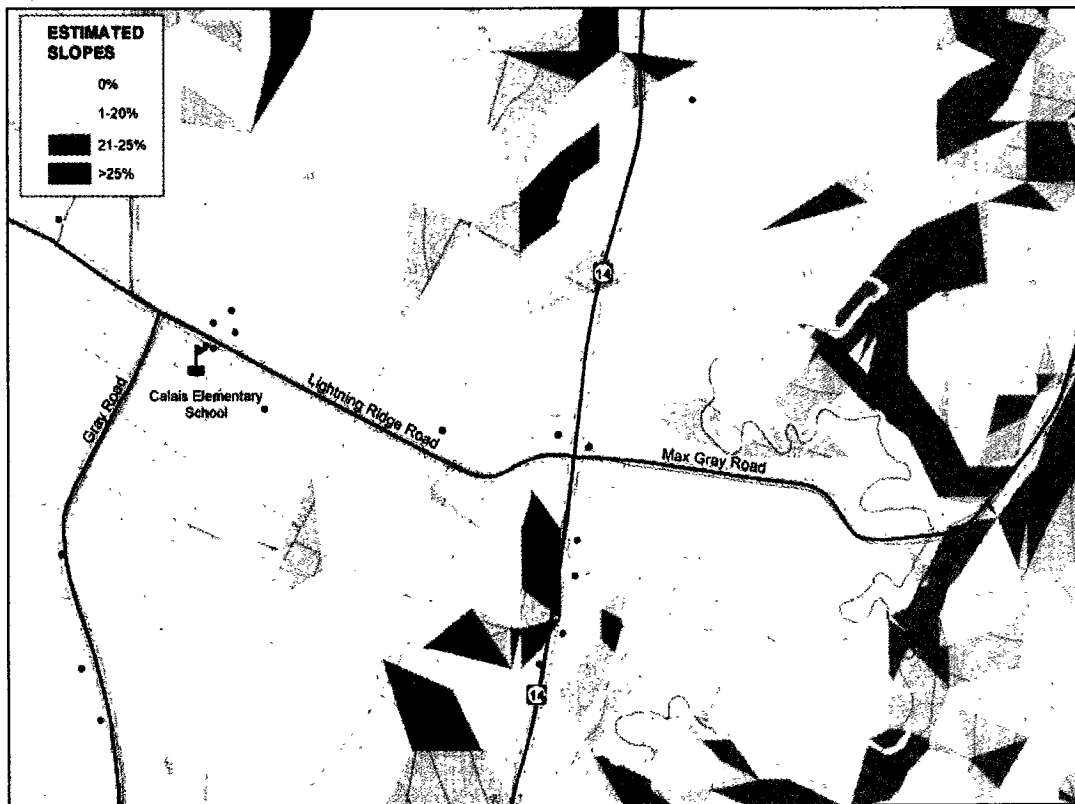
**Figure 32: FEMA-Designated Floodplain In VT 14-Lightning Ridge Road Study Area****Resources – Slopes**

Figure 33 shows a composite image of estimated slopes in the VT 14-Lightning Ridge Road study area. Areas with greater than 20% slope in the study area, shown in red and orange, can be found generally southwest of the VT 14-Lightning Ridge Road-Max Gray Road intersection.



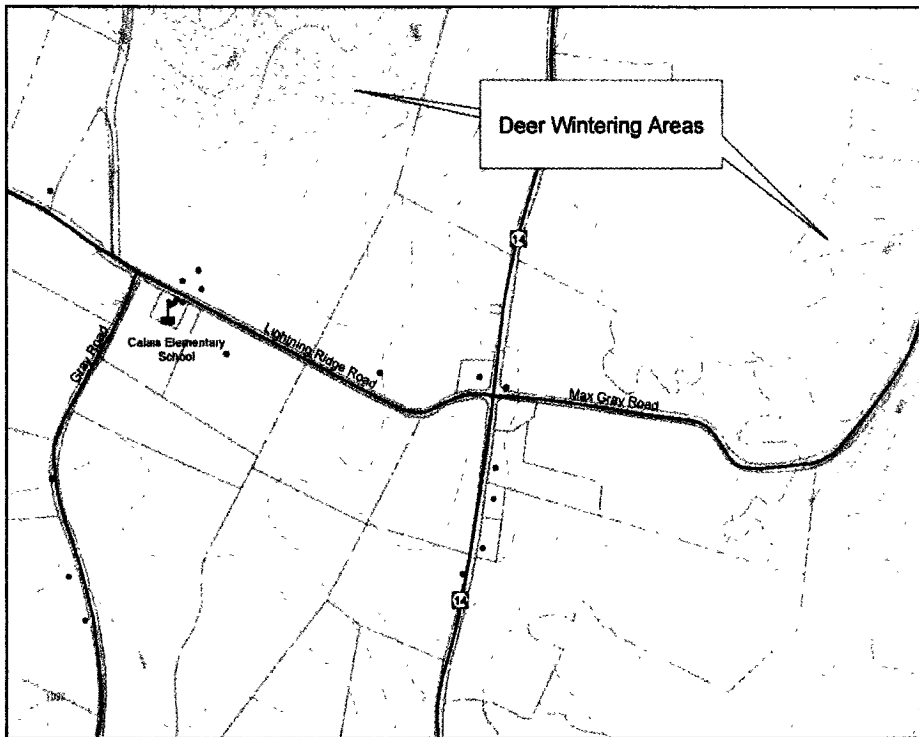
Figure 33: Estimated Slopes in VT 14-Lightning Ridge Road Study Area

**Resources – Endangered Species**

The VT 14-Lightning Ridge Road study area was investigated for the presence of rare, threatened, or endangered species or significant communities as defined by the Vermont Department of Fish and Wildlife. No locations were identified within the study area.

Figure 34 shows the deer wintering areas adjacent to the VT 14-Lightning Ridge Road study area, based on boundaries established by the Vermont Agency of Natural Resources. Deer wintering areas generally begin at the edge of mature coniferous tree cover. Any disturbance on identified deer wintering areas may require mitigation.



**Figure 34: Deer Wintering Areas in VT 14-Lightning Ridge Road Study Area****Resources – Agricultural Lands**

There are two identified active agricultural lands adjacent to the study area east of VT 14 north and south of Max Gray Road, respectively. The field located south of Max Gray Road has been identified as a Machias Fine Sandy Loam soil which is listed as a prime agricultural soil. The field located to the north of Max Gray Road has been identified as a Nicholville Silt Loam soil and is listed as a soil of statewide importance. If Federal funding is to be used for improvements that encroach on either of these fields the requirements of the Farmland Protection Policy Act must be observed.



## ALTERNATIVES ANALYSIS

Five alternatives were developed for the VT 14-Lightning Ridge Road-Max Gray Road study area for evaluation and comparison. These alternatives are the result of an examination of existing conditions and recommendations from state, regional, and local officials and Calais residents. The alternatives are evaluated based on their cost, engineering elements, environmental, historic and archeological impacts, required permits, their ability to satisfy the project area Purpose and Need and their feasibility for implementation.

Table 24 identifies the five VT 14-Lightning Ridge Road-Max Gray Road alternatives.

**Table 24: VT 14-Lightning Ridge Road-Max Gray Road Alternatives**

Alternative 1: Do Nothing
Alternative 2: Base Improvements
Alternative 3: Existing Alignment - Reconfigured Approaches & Improved Signage
Alternative 4: Existing Alignment - Leveled VT 14
Alternative 5: Southern Alignment

### ALTERNATIVE 1: DO NOTHING

#### *Overview*

This alternative would leave the existing facilities in their current condition.

#### *Impact*

- Cost: No cost associated with this alternative.
- Engineering: No physical changes associated with this alternative.
- Impacts: No identified environmental, archeological, or historic impacts associated with this alternative.
- Local and Regional Issues: This alternative does not satisfy any of the recommendations of the Regional Transportation Plan or this study area's Purpose and Need statement.
- Permits: No permits would be required for this alternative.
- Other: No local funding match is required for this alternative.

### ALTERNATIVE 2: BASE IMPROVEMENTS

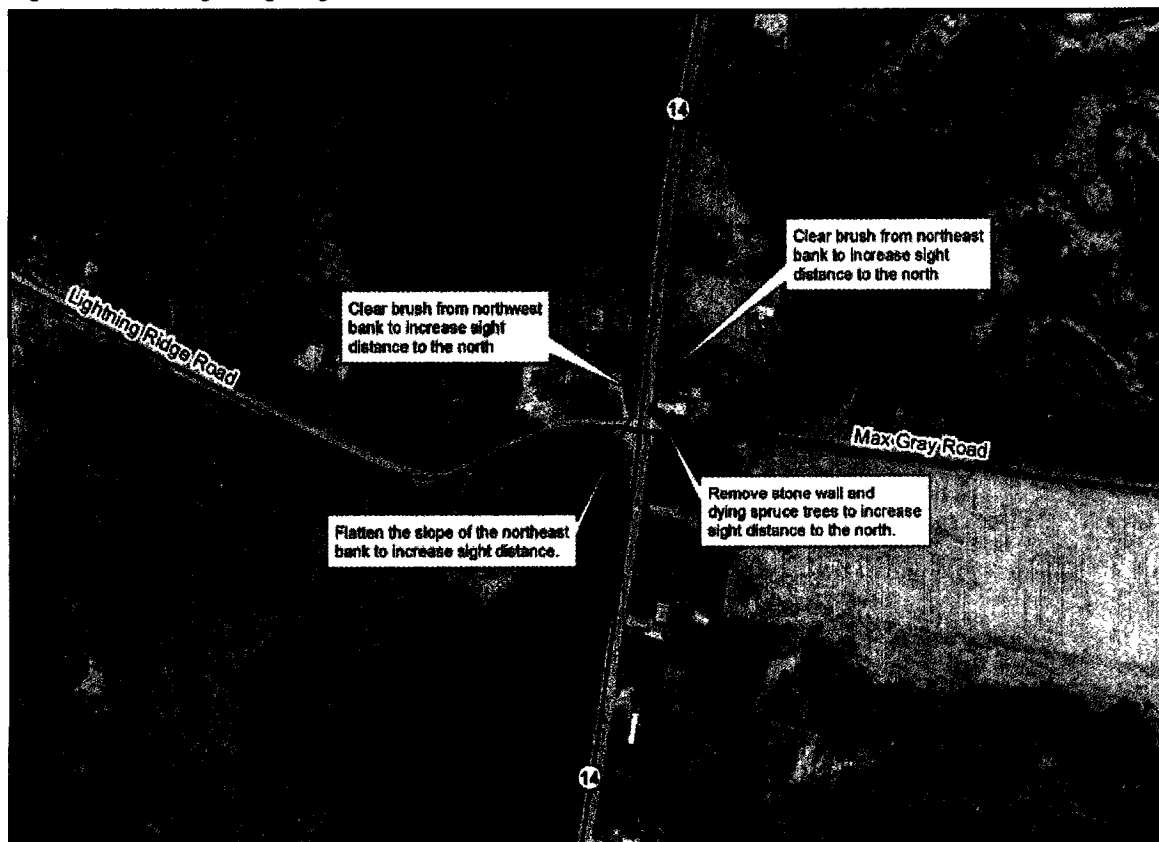
#### *Overview*

The identified base improvements involve safety improvements that can be implemented in the near term at a relatively low cost (Figure 35).



- Clear vegetation and brush from northeast and northwest banks adjacent to the intersection to increase sight distance to the north
- Remove the stone wall and the two spruce trees from the northeast corner to increase sight distance to the north
- Flatten the slope of the bank on the northeast corner to increase sight distance to the north.

Figure 35: VT 14-Lightning Ridge Road Alternative #2



### Impact

- Cost: The approximate cost for this alternative, which includes brush clearing, slope alterations, and removal of a stone wall and trees is \$13,500.
- Engineering: This alternative would improve traffic safety through brush clearing, slope alterations, and the removal of a stone wall and trees. The alternative would not change multimodal accessibility or hydraulic performance.
- Impacts: No identified environmental, archeological, or historic impacts associated with this alternative.



- Local and Regional Issues: This alternative would not significantly impact community character or economic conditions. Certain elements of this alternative, such as improving sight distance and vehicle safety do conform to the Regional Transportation Plan. This alternative scores 5 points out of a possible 50 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- Permits: There are no identified permits that this alternative would require.
- Other: A local funding match would be required for elements of this alternative.

### **ALTERNATIVE 3: EXISTING ALIGNMENT - RECONFIGURED APPROACHES & IMPROVED SIGNAGE**

#### ***Overview***

Alternative 3 includes the base elements of Alternative 2 plus the narrowing of the Lightning Ridge Road approach to VT 14, the shortening of the passing zone on VT 14 north of the intersection, and the addition of a northbound left turn lane on VT 14 (Figure 36).

#### **Base Improvements**

- Clear vegetation and brush from northeast and northwest banks adjacent to the intersection to increase sight distance to the north
- Remove the stone wall and the two spruce trees from the northeast corner to increase sight distance to the north
- Flatten the slope of the bank on the northeast corner to increase sight distance to the north.

#### **Geometric Improvements**

- Narrow Lightning Ridge Road approach to force vehicles to stop in a location that maximizes sight distance to the north and south.
- Paint a stop bar at Lightning Ridge Road approach and add center-line striping.
- Pave a 15-foot apron and paint a stop bar at Max Gray Road approach.
- Shorten the passing zone on VT 14 north of the intersection to slow traffic and to eliminate a complex maneuver near the intersection
- Add a left turn lane for northbound VT 14 approach to reduce rear-end collisions.

#### **Signage**

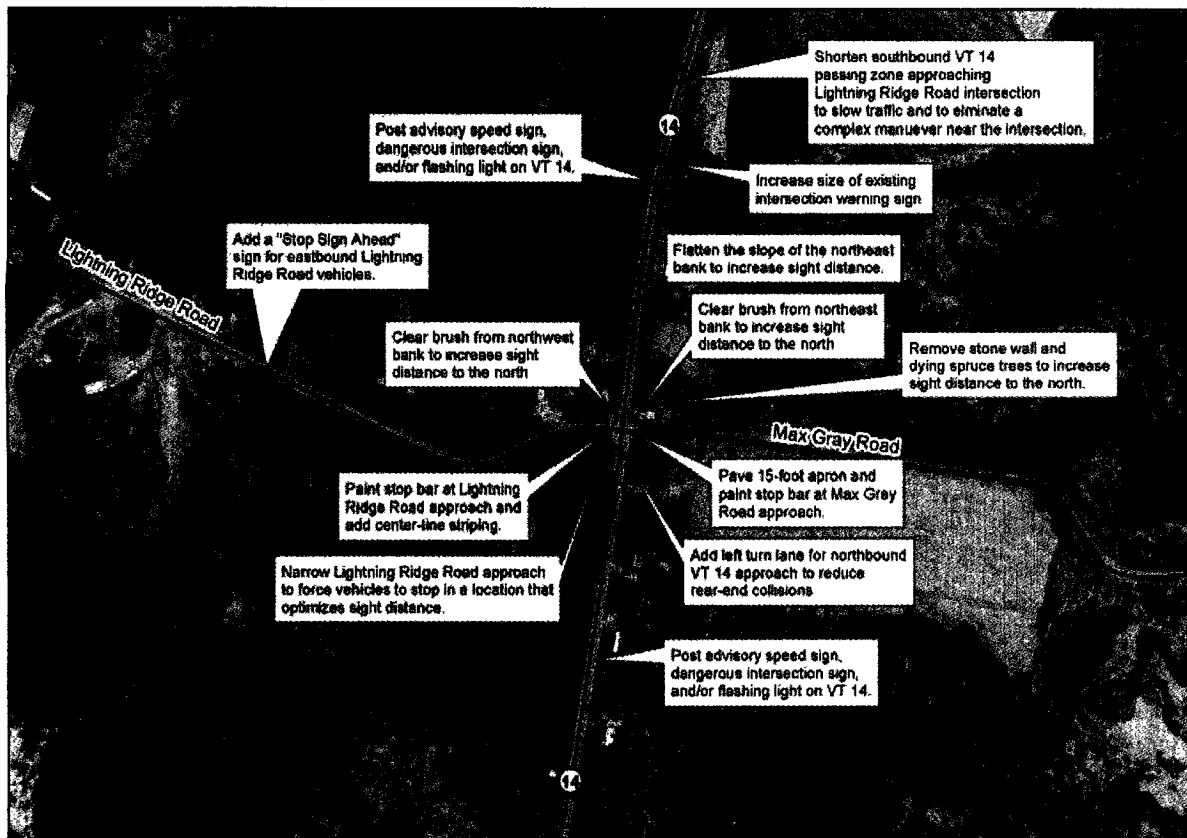
- Add a "stop sign ahead" sign for eastbound Lightning Ridge Road vehicles approaching VT 14.
- Post advisory speed sign, dangerous intersection sign, and/or flashing light on VT 14 north and south of intersection. The Manual on Uniform Traffic Control Devices (FHWA, 2003) recommends utilizing flashing warning beacons under the following situations: 1) At obstructions in or immediately adjacent to the roadway; 2) As supplement emphasis to regulatory



or warning signs; 3) As emphasis for midblock crosswalks; 4) On approaches to intersections where additional warning is required, or where special conditions exist; and 5) As supplements to regulatory signs.

- Increase the size of the intersection warning sign north of the intersection

Figure 36: VT 14-Lightning Ridge Road Alternative #3



### Impact

- **Cost:** The approximate cost for this alternative, which includes brush clearing, slope alterations, removal of a stone wall and trees, new signage and striping, a new left turn lane on VT 14, narrowing the Lightning Ridge Road approach, and shortening the southbound VT 14 passing zone is \$136,100.
- **Engineering:** This alternative would improve traffic safety through brush clearing, slope alterations, the removal of a stone wall and trees, new signage and striping, a new left turn lane on VT 14, narrowing the Lightning Ridge Road approach, and shortening the southbound VT 14 passing zone. The alternative would not change multimodal accessibility or hydraulic performance.





- Impacts: The identified impacts of this alternative include potential archeological impacts associated with the widening of VT 14 to accommodate a new northbound left turn lane at the Lightning Ridge Road-Max Gray Road intersection.
- Local and Regional Issues: This alternative would not significantly impact community character or economic conditions. Certain elements of this alternative, such as improving sight distance and vehicle safety do conform to the Regional Transportation Plan. This alternative scores 45 points out of a possible 50 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- Permits: There are no identified permits that this alternative would require.
- Other: A local funding match would be required for elements of this alternative.

#### **ALTERNATIVE 4: EXISTING ALIGNMENT - LEVELED VT 14**

##### ***Overview***

Alternative 4 includes the base elements of Alternative 2 plus the flattening of the vertical curvature of VT 14 north of Lightning Ridge Road to improve sight distance (Figure 37).

##### **Base Improvements**

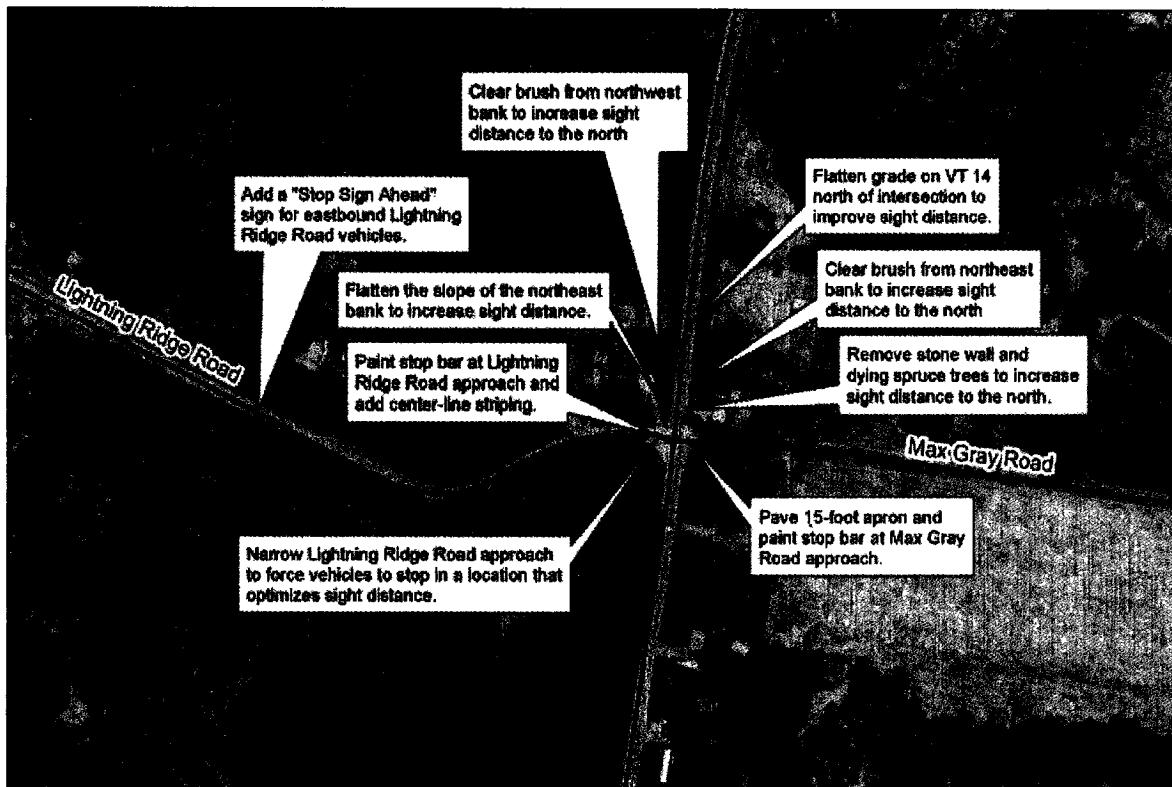
- Clear vegetation and brush from northeast and northwest banks adjacent to the intersection to increase sight distance to the north
- Remove the stone wall and the two spruce trees from the northeast corner to increase sight distance to the north
- Flatten the slope of the bank on the northeast corner to increase sight distance to the north.

##### **Additional Improvements**

- Flatten the grade on VT 14 north of intersection to improve sight distance. Soil conditions, cost estimates, and relative impacts will dictate whether the grade is flattened by cutting or filling soil.
- Pave a 15-foot apron and paint a stop bar at the Max Gray Road approach.
- Narrow the Lightning Ridge Road approach to force vehicles to stop in a location that maximizes sight distance to the north and south.
- Paint a stop bar at the Lightning Ridge Road approach and add center-line striping
- Add a "stop sign ahead" sign for eastbound Lightning Ridge Road vehicles approaching VT 14.



Figure 37: VT 14-Lightning Ridge Road Alternative #4



### Impact

- **Cost:** The approximate cost for this alternative, which includes brush clearing, slope alterations, removal of a stone wall and trees, new signage and striping, narrowing the Lightning Ridge Road approach, and flattening the grade on VT 14 north of the intersection is \$261,800.
- **Engineering:** This alternative would improve traffic safety through brush clearing, slope alterations, the removal of a stone wall and trees, new signage and striping, narrowing the Lightning Ridge Road approach, and flattening the grade on VT 14 north of the intersection. The alternative would not change multimodal accessibility or hydraulic performance.
- **Impacts:** No identified environmental, archeological, or historic impacts associated with this alternative.
- **Local and Regional Issues:** This alternative would not significantly impact community character or economic conditions. This alternative does conform to the Regional Transportation Plan. This alternative scores 40 points out of a possible 50 points in terms of satisfying the identified study area Purpose and Need (see following section, "Purpose and Need Matrix" for details).
- **Permits:** There are no identified permits that this alternative would require.
- **Other:** A local funding match would be required for elements of this alternative.



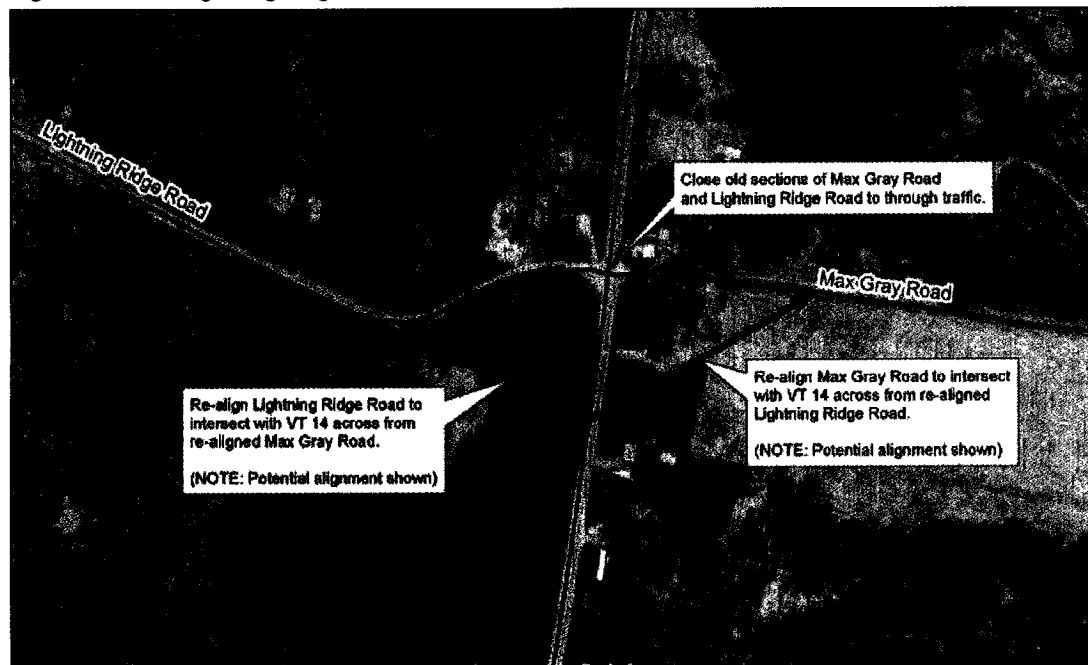
## ALTERNATIVE 5: SOUTHERN ALIGNMENT

### Overview

Alternative 5 includes the re-alignment of Lightning Ridge Road and Max Gray Road to intersect with VT 14 south of their current location (Figure 38).

- Re-align Lightning Ridge Road and Max Gray Road to meet VT 14 further south.
- The estimated slope for the proposed Lightning Ridge Road alignment would drop approximately 50 feet in 500 feet of horizontal distance, a 10% average slope, which matches the VT State Design Standards of 10% for a rural local road. More detailed land survey data would be needed to confirm the maximum slope values.
- Close old sections of Max Gray Road and Lightning Ridge Road to through traffic.
- Add appropriate signage and striping to new two-way stop controlled intersection.

Figure 38: VT 14-Lightning Ridge Road Alternative #5



### Impact

- Cost: The approximate cost for this alternative which includes the re-alignment of Lightning Ridge Road and Max Gray Road is \$440,600. This is the most expensive of the five alternatives.



- **Engineering:** This alternative would improve traffic safety through the re-alignment of Lightning Ridge Road and Max Gray Road. The alternative would not change multimodal accessibility or hydraulic performance. The alternative would involve an alignment change of Lightning Ridge Road and Max Gray Road.
- **Impacts:** The identified impacts of this alternative include potential agricultural land impacts from the Max Gray Road re-alignment, potential historic impacts to a 19<sup>th</sup> century schoolhouse site from the re-alignment of Lightning Ridge Road, potential floodplain, fish and wildlife, and wetlands impacts from the re-alignment of Max Gray Road, potential construction on steep slopes, and potential noise impacts from the re-alignment of Lightning Ridge Road and Max Gray Road. This alternative also impacts the largest amount of total land – approximately 1.4 acres.
- **Local and Regional Issues:** This alternative would not significantly impact community character or economic conditions. This alternative does conform to the Regional Transportation Plan. This alternative scores 40 points out of a possible 50 points in terms of satisfying the identified study area Purpose and Need (see following section, “Purpose and Need Matrix” for details).
- **Permits:** The identified permits for this alternative include a 401 Water Quality permit, a 404 Corps of Engineers permit, a Conditional Use Determination permit, and a Stream Alteration permit for the new Max Gray Road alignment, and a Stormwater Discharge permit for the new Lightning Ridge Road and Max Gray Road alignments. This alternative may not be characterized as a *Categorical Exclusion* under the National Environmental Policy Act (NEPA) as defined in a Programmatic Agreement between the Vermont Agency of Transportation and the Federal Highway Administration due to potential impacts from the new Lightning Ridge Road and Max Gray Road alignments (See Appendix M for full text of Agreement).
- **Other:** A local funding match would be required for elements of this alternative.

## PURPOSE AND NEED MATRIX

To assist in determining how closely each alternative satisfies the study area Purpose and Need, we have developed the Purpose and Need Matrix shown in Table 25 below. The VT 14-Lightning Ridge Road-Max Gray Road study area purpose is to *improve safety at the VT 14-Lightning Ridge Road-Max Gray Road intersection*. The needs identified to achieve this goal comprise the rows of the matrix.

Each of the alternatives is given a rating of “not met”, “partially met”, or “fully met” with respect to each of the study area needs. A “not met” rank is given 0 points, a “partially met” rank is given 5 points, and a “fully met” rank is given 10 points. The total points for each alternative is summed and shown at the bottom of the table. The maximum score is 50 points.

Alternative 1, which involves no improvements scores the lowest with 0 points. Alternative 3, which involves the reconfiguration of the Lightning Ridge Road and Max Gray Road approaches and improved signage and striping, scores the highest with 45 points. Alternative 3 scores higher than



Alternatives 4 and 5 because it satisfies the need to slow speeds at the study intersection, whereas Alternatives 4 and 5 only improve traffic operations and sight distance at the intersection. The results of the Purpose and Need Matrix are utilized in the Evaluation Matrix described in the previous section.

**Table 25: VT 14-Lightning Ridge Road-Max Gray Road: Purpose and Need Evaluation Matrix**

NEEDS	Alternative 1 Do Nothing	Alternative 2 Base Improvements	Alternative 3 Existing Alignment - Reconfigured Approaches & Improved Signage	Alternative 4 Existing Alignment - Leveled VT 14	Alternative 5 Southern Alignment
<b>Safety</b>					
Increase sight distance at VT 14-Lightning Ridge Road-Max Gray Road intersection	○	⊙	⊙	●	●
Slow speeds at VT 14-Lightning Ridge Road-Max Gray Road intersection	○	○	●	○	○
Pave and stripe Max Gray Road approach	○	○	●	●	●
Add stop sign on Lightning Ridge Road eastbound approaching VT 14	○	○	●	●	●
Reconstruct Lightning Ridge Road approach to narrow approach and add center line striping.	○	○	●	●	●
○ Not Met	Not Met	5 x 0 = 0	4 x 0 = 0	0 x 0 = 0	1 x 0 = 0
⊙ Partially Met	Partially Met	0 x 5 = 0	1 x 5 = 5	1 x 5 = 5	0 x 5 = 0
● Fully Met	Fully Met	0 x 10 = 0	0 x 10 = 0	4 x 10 = 40	4 x 10 = 40
<b>TOTAL POINTS</b>		<b>0</b>	<b>5</b>	<b>45</b>	<b>40</b>

## EVALUATION MATRIX

An Evaluation Matrix (Table 26) has been developed to objectively quantify and rate the five alternatives developed for the VT 14-Lighting Ridge Road -Max Gray Road study area. The matrix presents comparable results related to alternative cost, engineering factors, impacts, local and regional issues, permits needed, and other related issues.

The costs identified in the matrix are based on the VTrans Preliminary Engineering unit price list and other engineering cost estimation resources. The costs are order of magnitude based upon rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.

The impacts and required permits identified in the matrix are based on existing cultural, historic, archeological, and environmental data and maps as well as comments received from state and federal regulatory agencies.

As the scope of this project did not allow for detailed survey measurements, some of the impacts in the Evaluation Matrix have been approximated. Where a matrix element could not be defined conclusively, a conservative assumption was always made (i.e. higher cost, required permit, potential impact, etc.). A more formal investigation, involving detailed surveys will be required to determine precise implementation costs, impacts, and required permits for the selected alternative(s).



Table 26: VT 14 – Lightning Ridge Road – Max Gray Road Evaluation Matrix

		Alternative 1 Do Nothing	Alternative 2 Base Improvements	Alternative 3 Existing Alignment - Reconfigured Approaches & Improved Signage	Alternative 4 Existing Alignment - Leveled VT 14	Alternative 5 Southern Alignment
COST	Includes Engineering Costs and 50% Contingency	\$0	\$13,500	\$136,100	\$261,800	\$454,100
ENGINEERING	Traffic Safety	No Change	Improve	Improve	Improve	Improve
	Alignment Change	No Change	No	No	No	Yes
	Bicycle/Pedestrian Access	No Change	No Change	No Change	No Change	No Change
	Hydraulic Performance	No Change	No Change	No Change	No Change	No Change
IMPACTS	Agricultural Lands	No	No	No	No	Possible (Meadow SE of intersection)
	Archaeological	No	Possible (New NB VT 14 left turn lane)	Possible (New NB VT 14 left turn lane)	Possible (New NB VT 14 left turn lane)	Possible (New NB VT 14 left turn lane)
	Historic Structures/Sites	No	No	No	No	Possible (19th century school house site SW of intersection)
	Floodplain	No	No	No	No	Possible (New Max Gray Road Alignment)
	Fish and Wildlife	No	No	No	No	Possible (New Max Gray Road Alignment)
	Impacted Land (Acres)	0 acre	0 acre	< 1 acre	< 1 acre	1.4 acres
	Rare, Threatened & Endangered Species	No	No	No	No	No
	Public Lands	No	No	No	No	No
	Noise	No	No Change	No Change	No Change	Increase along new alignments
	Wetlands	No	No	No	No	Possible (New Max Gray Road Alignment)
LOCAL & REGIONAL ISSUES	Community Character	No Change	No Change	No Change	No Change	No Change
	Economic Impacts	No Change	No Change	No Change	No Change	No Change
	Conformance to Regional Transportation Plan	No	Partial	Partial	Yes	Yes
	Satisfies Purpose & Need	No	5	45	40	40
PERMITS	Act 250	No	No	No	No	No
	401 Water Quality	No	No	No	No	Possible (New Max Gray Road Alignment)
	404 Corps of Engineers Permit	No	No	No	No	Possible (New Max Gray Road Alignment)
	Stream Alteration	No	No	No	No	Possible (New Max Gray Road Alignment)
	Conditional Use Determination	No	No	No	No	Possible (New Max Gray Road Alignment)
	Storm Water Discharge	No	No	No	No	Possible (New Max Gray Rd and Lightning Ridge Rd alignments)
	Shoreland Encroachment	No	No	No	No	No
	Endangered & Threatened Species	No	No	No	No	No
	State Historic Preservation Office Clearance	No	No	No	No	No
	NEPA: Categorical Exclusion	No	No	No	No	Possible (New Max Gray Rd and Lightning Ridge Rd alignments)
OTHER	Local Funding Match	No	Yes	Yes	Yes	Yes

## RECOMMENDED ALTERNATIVE

Based on comments received by local, regional and state officials and local residents, adherence to the study area Purpose and Need Statement, and scoring in the Evaluation Matrix, the recommended alternative is Alternative # 3: Existing Alignment - Reconfigured Approaches & Improved Signage.

Of the five alternatives evaluated in this study, Alternative # 3 is one of the least expensive (\$136,100) to implement, it provides a significant improvement in traffic safety at the study intersection, it involves relatively minor impacts resulting from the new VT 14 left turn lane, it sufficiently satisfies the objectives of the Regional Transportation Plan, it scores the highest on the Purpose and Need



Matrix, and it would likely not involve any major permits to implement. Although the left turn lane is not specifically warranted based on accident history or traffic/delay guidelines (see Appendix K), it is an important feature of the alternative for safe operations because the high speed limit along VT 14 creates the potential for severe accidents at this intersection. By removing left turning vehicles from the through VT 14 flow, the opportunity for these severe accidents in the future is reduced. The cost to add a northbound left turn lane at this intersection is estimated to be approximately \$70,000.

#### **ELEMENTS OF THE RECOMMENDED ALTERNATIVE**

The recommended alternative involves clearing vegetation and flattening the slope along the banks adjacent to the intersection to improve sight distance, narrowing the Lightning Ridge Road approach to VT 14, shortening the passing zone on VT 14 north of the intersection, and adding a northbound left turn lane on VT 14 (Figure 39).

##### General Improvements:

- Clear vegetation and brush from northeast and northwest banks adjacent to the intersection to increase sight distance to the north
- Remove the stone wall and the two spruce trees from the northeast corner to increase sight distance to the north
- Flatten the slope of the bank on the northeast corner to increase sight distance to the north.

##### Geometric Improvements:

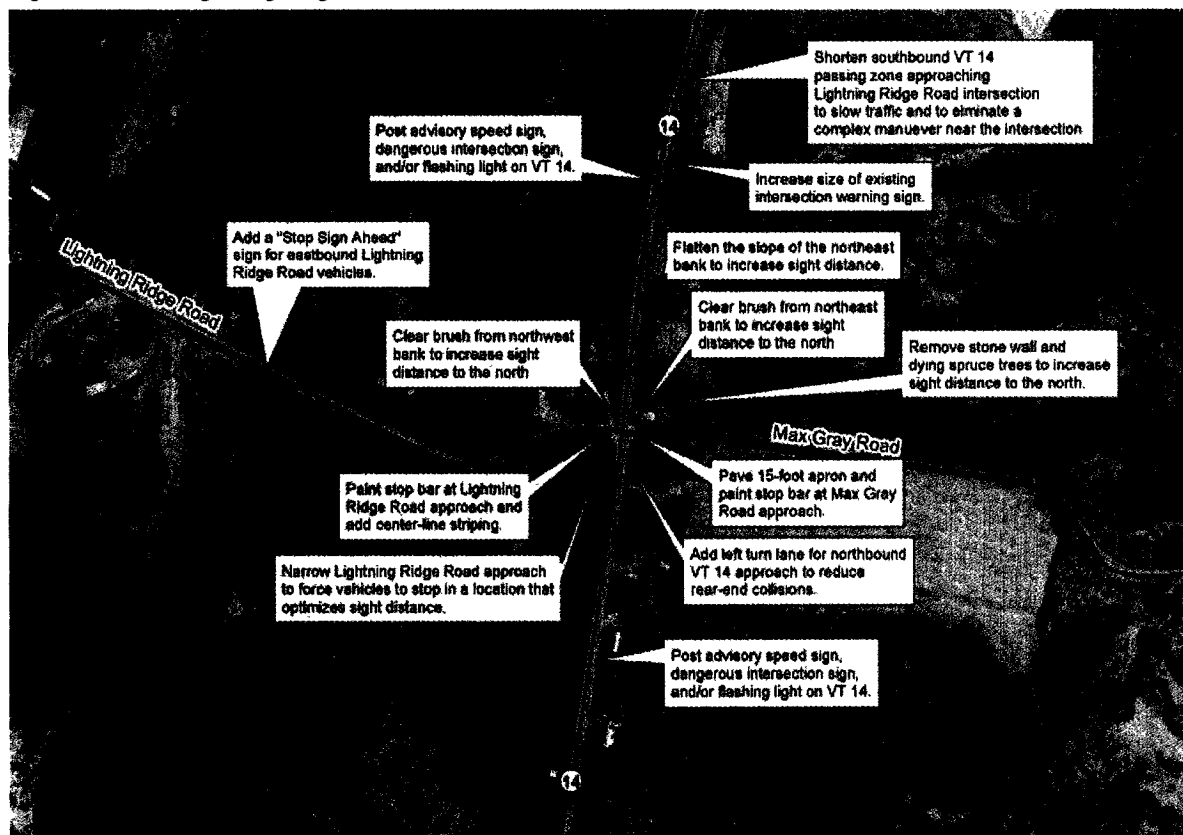
- Narrow the Lightning Ridge Road approach to force vehicles to stop in a location that maximizes sight distance to the north and south.
- Paint a stop bar at the Lightning Ridge Road approach and add center-line striping.
- Pave a 15-foot apron and paint a stop bar at the Max Gray Road approach.
- Shorten the passing zone on VT 14 north of the intersection to slow traffic and to eliminate a complex maneuver near the intersection.
- Add a left-turn lane for northbound VT 14 approach to reduce rear-end collisions.

##### Signage

- Add a "stop sign ahead" sign for eastbound Lightning Ridge Road vehicles approaching VT 14.
- Post an advisory speed sign, dangerous intersection sign, and/or flashing light on VT 14 north and south of intersection
- Increase the size of the intersection warning sign north of the intersection



Figure 39: VT 14-Lightning Ridge Road: Recommended Alternative



## IMPLEMENTATION OF RECOMMENDED ELEMENTS

Figure 40 below shows the individual elements associated with each of the recommended alternative for the VT 14-Lightning Ridge Road intersection along with an estimated timeframe for implementation and an estimated cost for each element. The estimated timeframe (i.e. less than one year, between one to five years, five or more years) is based on the projected ease and number of steps required for implementation. The brush trimming adjacent to the intersection, for example, would be relatively easy to implement, requiring only town staff labor and time. On the other hand, the construction of the northbound left turn lane on VT 14 could take more than five years due to potential right of way and environmental impacts, time for surveys, design and engineering, and securing funding for construction.





Figure 40: VT 14-Lightning Ridge Road Intersection Implementation Schedule

	TIMEFRAME			Estimated Cost (1)
	< 1 Year	1 - 5 Years	5+ Years	
Brush clearing at NE & NW corner of intersection*				\$1,500
Flatten slope of NE bank to increase sight distance				\$7,000
Remove stone wall and spruce trees on NW corner to increase sight distance				\$5,000
Post intersection advisory signage on VT 14 north and south of intersection				\$300
Post "Stop Sign Ahead" sign for eastbound Lightning Ridge Road vehicles				\$300
Add stop bar on Lightning Ridge Rd approach and add center line striping				\$3,000
Narrow Lightning Ridge Road approach (currently 90' wide apron on Lightning Ridge Rd)**				\$40,000
Add left-turn lane for northbound VT 14 vehicles				\$70,000
Pave 15-foot apron and paint stop bar on Max Gray Road approach				\$5,000
Shorten southbound VT 14 passing zone north of intersection				\$4,000
<b>Footnotes:</b> * Slope cutting or slope filling to be determined based on soil conditions, cost, and impacts ** Ensure that new approach can still accommodate truck and school bus turning movements safely (1) The costs are order of magnitude based on rough estimates of the quantities associated with each alternative. Engineering costs are included as well as a 50% contingency. Right of way costs have not been included.				



